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Collaborating with Catastrophe: The User's Guide to

Patricia Cafferky

COLLABORATING WITH CATASTROPHE:
THE USER'S GUIDE TO POST-APOCALYPTIC FARMING

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OIL USE PER CAPITA V. COUNTRY/REGION

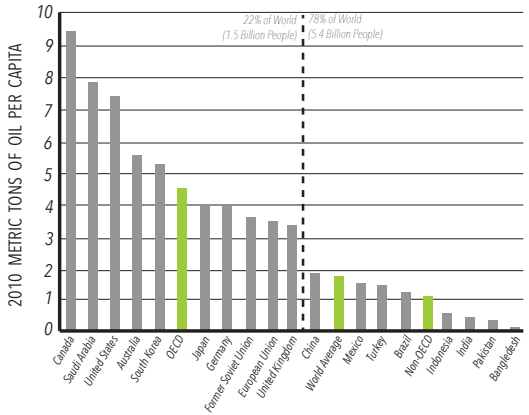


FIGURE 1

U.S. GREENHOUSE GAS EMISSIONS BY SECTOR

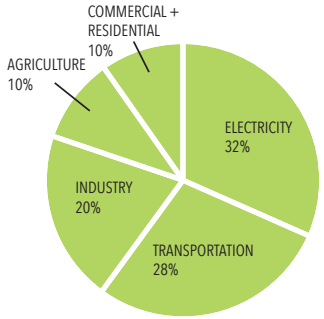


FIGURE 2

POPULATION GROWTH V. TOTAL ENERGY CONSUMPTON

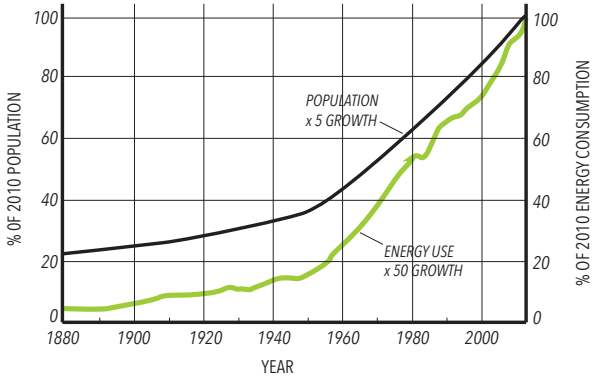


FIGURE 3

INTRODUCTION
THE JEREMIAD

A Jeremiad in literature is a work of prose which bitterly laments the sins and moral failings of society, followed by a prophecy of it's imminent downfall as a result of those failings, attacking society's flaws in the hopes of inspiring a reform and potentially a brighter future. The term originates from the Book of Jeremiah in the Old Testament, in which the prophet attributes the calamities of Israel to the breaking of the Lord's covenant, prophesizes the impeding downfall of the Kingdom of Judah and then calls on the people to repent and reform. This rhetorical device has been utilized for a range of purposes since, including theologians such as Jonathan Edwards and Martin Luther King, Jr. who used it in sermons, to more contemporary authors like Mike Davis. In Davis's book *Ecology of Fear: Los Angeles and the Imagination of Disaster*, he describes in detail the destruction which plagued southern California at the end of the 20th century, linking it to the naivety of the region's human inhabitants, and finally extrapolating the effects of present day actions forward onto a bleak future Los Angeles.[1] Davis uses the jeremiad technique as a means of communicating the ramifications of the mankind's decisions, imploring humanity to change.

Understanding that architectural projects are fictions driven by the internal narrative of designers, architecture should be able to achieve the same effect as a written narrative, and so a jeremiad could successfully be told by a design process and product - the process being inspired by man's modern day mistakes, and the product being a dystopian future design. "Collaborating with Catastrophe" seeks to utilize the techniques of the jeremiad in the realm of architecture in order to investigate and predict the possible ramifications of present day decisions on both the built and social future.

> "The scientific community is telling us if we do not address the global crisis of climate change, transform our energy system away from fossil fuel to sustainable energy, the planet that we're going to be leaving our kids and our grandchildren may well not be habitable. That is a major crisis."
>
> -Bernie Sanders, *The Huffington Post*[2]

Most scientific agencies in the United States are in agreement that climate change is occurring, including NASA and NOAA, and that human activities are a major contributing factor.[3] The logical response to this knowledge would be a drastic change in lifestyles to halt climate change - yet instead, there is a growing dependence of first world countries on energy derived from fossil fuels (Figures 1,2,3). In David Hughes's book *Drill, Baby, Drill*, he states, "world energy consumption has more than doubled since the energy crises of the 1970s, and more than 80 percent of this is provided by fossil fuels. In the next 24 years world consumption is forecast to grow by a further 44 percent–and U.S. consumption a further seven percent–with fossil fuels continuing to provide around 80 percent of total demand".[4] This is a major failing of modern day society, and one which is going to have permanent and devastating consequences.

1. Davis, Mike. *Ecology of Fear: Los Angeles and the Imagination of Disaster*. New York: Metropolitan Books, 1998.

2. Sheppard, Kate. "Bernie Sanders: Climate Change Is The Biggest National Security Threat." The Huffington Post. October 13, 2013.

3. "Climate Change Facts: Answers to Common Questions." EPA.. http://www3.epa.gov/climatechange/basics/facts.html.

4. Hughes, J. David. *Drill, Baby, Drill: Can Unconventional Fuels Usher in a New Era of Energy Abundance?* (Santa Rosa, CA: Post Carbon Institute, 2013) i.

FIGURE 1
Hughes, J. David. *Drill, Baby, Drill: Can Unconventional Fuels Usher in a New Era of Energy Abundance?* (Santa Rosa, CA: Post Carbon Institute, 2013) 6.

FIGURE 2
"President Obama's Plan to Fight Climate Change." The White House.

FIGURE 3
Hughes, J. David. *Drill, Baby, Drill: Can Unconventional Fuels Usher in a New Era of Energy Abundance?* (Santa Rosa, CA: Post Carbon Institute, 2013) 4.

This lack of response is due chiefly to two things. The first is neo-liberal society's reliance on increasing quantities of energy, which renewable energy sources are not yet able to provide more than a fraction of (Figure 7). In Matthew Huber's book *Lifeblood: Oil, Freedom, and the Forces of Capitalism,* Huber argues that inherent to capitalism is its "tendency to degrade the conditions of production, which include ecological systems such as water systems, soil fertility, and the climate" - which implies that halting climate change would require a complete overhaul of modern day social, economic, and political structures.[5] This sounds absurd, but when the alternative is a potentially uninhabitable future Earth, why would humanity not make the necessary changes?

The answer to this question lies in the second reason for the lack of response, which is the developed world's separation from the places of energy extraction and production. Although per capita the citizens of the U.S. use 4.2x the amount of energy that the people of non-OECD countries, they do not see the destructive processes or the toxic side effects (Figure 3). This creates a mental disconnect between an oil field in Saudi Arabia and the electricity a westerner uses when they turn on a television, even though the two are linked by necessity. It is also an inherent truth of climate change that it disproportionally effects the world's poor the hardest, who live in regions which have the least economic, institutional, and technical ability to adapt.[6] This means that those populations which are the most to blame for climate change have the least reason to respond proactively.

One exception to this rule of energy production occurring out of view is the recently developed technology of hydraulic fracturing or "hydrofracking" - a controversial drilling technique to extract natural gas from geological shale formations miles underground. The United States is rich in these natural gas deposits and, as a result, there has been an explosion in the amount of drilling happening in places that were previously agrarian communities (Figure 4). Natural gas burns cleaner than either coal or oil, it's also relatively inexpensive to produce, and geologists estimate that there is enough natural gas to power America for the next hundred years, which many believe will lead the country into a clean, energy independent future (Figures 5,6).

While this sounds ideal, it ignores that fact that although natural gas is *cleaner* than coal or oil, it is still not actually clean, emitting as much as 20x as much greenhouse gas as renewable energy sources (Figure 6) and, more importantly, the process of hydrofracking itself has been linked to polluting water, soil, and air - the extents of which are still unknown, but all of which is occurring in farming communities that rely on those natural resources.[7] In today's capitalist society, however, those risks have been largely ignored in the interest of a new, cheap source of energy.

If this thesis is a jeremiad, society's inability to change to become more sustainable is it's moral failing, and the predicted post-apocalypse is a result of the impending climate change. In imagining this future world, scientific analysis can help predict the problems that architecture and society will have to meet, from higher temperatures and sea levels, to new types of ecology and energy production (Figures 8,9).

5. Huber, Matthew. *Lifeblood: Oil, Freedom, and the Forces of Capital*. U of Minnesota, 2013. Print.

6. "The Inequality of Climate Change." The New York Times. November 12, 2013.

7. Prud'homme, A. (2014). *Hydrofracking: What Everyone Needs to Know*. New York, NY: Oxford University Press.

FIGURE 4
McKee, Scott. "United States Sets New Record for Natural Gas Production." Bipartisan Policy Center.

FIGURE 5
Hughes, J. David. Drill, *Baby, Drill: Can Unconventional Fuels Usher in a New Era of Energy Abundance?* (Santa Rosa, CA: Post Carbon Institute, 2013) .

FIGURE 6
"Greenhouse Gas Emissions Avoided through Use of Nuclear Generation." World Nuclear Association.

FIGURE 7
"Renewable Energy: Necessity, Not Nicety - The Inspiring Enterprise." The Inspiring Enterprise. November 3, 2015.

FIGURE 8
"Predicting Future Sea Level Rise." AntarcticGlaciersorg Dealing with Uncertainty Predicting Future Sea Level Rise Comments. February 14, 2014.

FIGURE 9
"U.S. and Global Temperature." Climate Change Indicators in the United States.

U.S. ANNUAL NATURAL GAS PRODUCTION

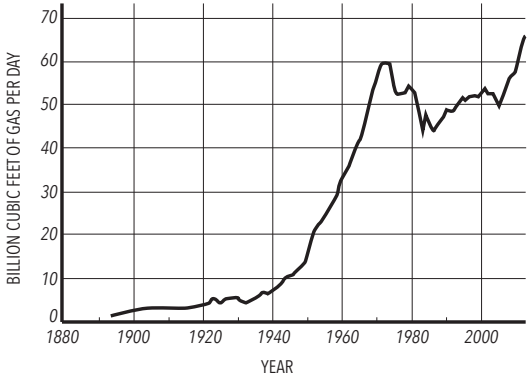


FIGURE 4

POWER TYPE	COST $/kW-hr
Geothermal	$0.05
Natural Gas	$0.07
Hydro-electric	$0.08
Coal	$0.10
Biomass	$0.10
Nuclear	$0.10
Solar PV	$0.13
Wind	$0.15
Solar Thermal	$0.24

FIGURE 5

GREENHOUSE GAS EMISSIONS BY ENERGY TYPE

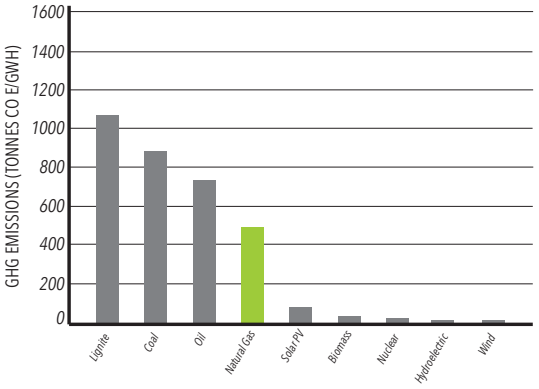


FIGURE 6

U.S. ENERGY CONSUMPTION BY SOURCE, 2014

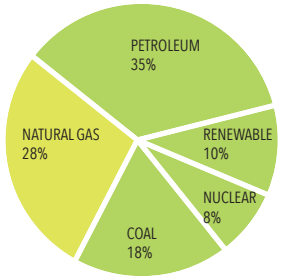


FIGURE 7

GLOBAL AVG. SEA LEVEL CHANGE

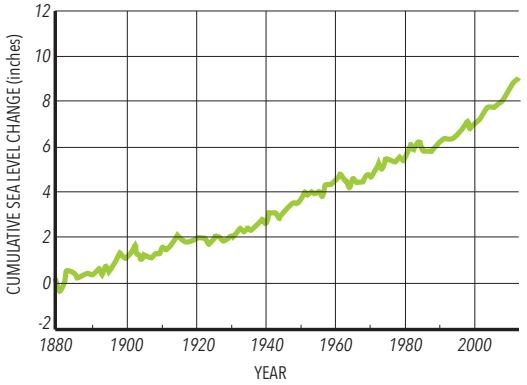


FIGURE 8

GLOBAL TEMPERATURE AND CARBON DIOXIDE

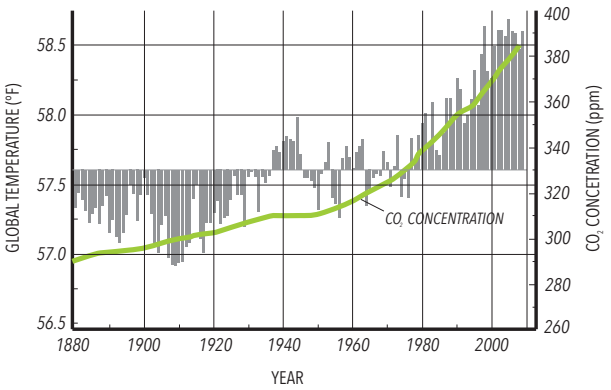


FIGURE 9

CONTENTION

The year is 2030 AD. Sea levels have risen, the ozone is breaking down, fresh water is increasingly scarce, and the ground beneath our feet in poinsoned. We've had to rapidly adapt our methods of food production, transit, and building shelter, to the harsh new conditions brought on by climate change and industrial pollution. Humanity is enduring, but only in the margins of what it once was. In the fight against global warming, architects believed their part to be in sustainable design, leading by example and attempting to slow the earth's rate of human induced decomposition. Society did not change radically enough, and the world suffered as a result.

This thesis contends that the narrative nature of architecture gives it the potential to act as a jeremiad, taking the present day failings of society in the face of climate change and extrapolating out a potential future dystopia to instigate a critical dialogue and challenge the status quo. Here, architecture will act as a medium, as opposed to more typical literary works or photojournalism techniques which are usually associated with communicating social critique.

The project "Walking City" by Ron Herron of Archigram uses this technique of designing for a future post-apocalyptic world as a method of cultural commentary - proposing absurd, artificially intelligent robot cities that would roam the world in search of resources. Although this is an impossible, unbuilt project set in an unknown future, it manages to be significant and awe-inspiring for exactly those reasons. "Collaborating with Catastrophe" is similarly set in a post-apocalyptic future, but provides a clear cause for the impending disaster and a clear program on which to focus the after-effects of such changes.

Jeremiads require a specific moral failing on which to focus. This thesis focuses on capitalism and it's inherent externalizing of costs on the environment, including water and ecological systems, soil fertility, and the climate.[8] This remains too broad, however, and so "Collaborating with Catastrophe focuses in on one of the most recently developed instances of capitalist externalization of cost in America - the process of Hydraulic Fracturing, or "Fracking". A harsh drilling process used to release natural gas from geological shale formations miles beneath the Earth's crust., the process is highly controversial, with numerous harmful side effects on the environment including, but not limited to, pollution of water sources, fugitive emissions, and destruction of the countryside – both spatially and socially.[9] Most concerning, however, is the programmatic overlap of fracking with agrarian America, where clean water and soil are relied upon to produce food for the country.

The second requirement of a jeremiad is the post-apocalyptic prediction, and so "Collaborating with Catastrophe" asks what would farming look like in not-so-distant year of 2030, if fracking pollution was worst case scenario and the rest of the environment had degraded as scientists predict it will. How ridiculous must the farming systems and technologies become in order to counteract the damage done to the countryside, and what does that world look like? The goal is to evoke commentary and deliberation about state of present and future society, much like Archigram's Walking City – capturing the sublimity and absurdity of unchecked human-caused destruction as a means of instigating change.

8. Huber, Matthew. *Lifeblood: Oil, Freedom, and the Forces of Capital*. U of Minnesota, 2013. Print.

9. Prud'homme, A. (2014). *Hydrofracking: What Everyone Needs to Know*. New York, NY: Oxford University Press.

FIGURE 10
"Walking City." Archigram Archival Project. 2010. Universty of Westminster. Web.

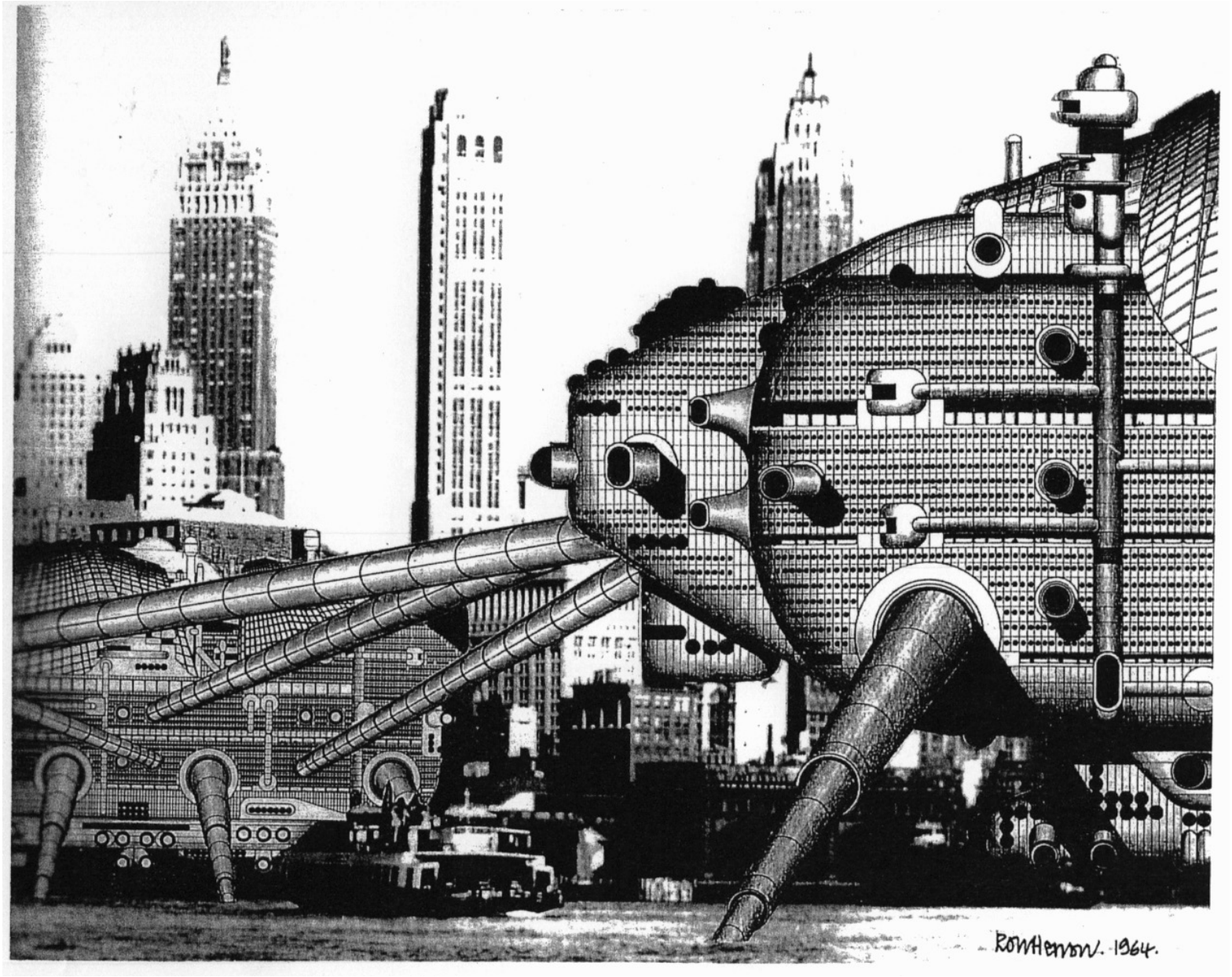


FIGURE 10

F[RA]CKING IT UP

The Fracking Song (My Water's On Fire Tonight). Studio 20, NYU. ProPublica.org. YouTube. May 11, 2011.

Water goes into the pipe, the pipe into the ground
The pressure creates fissures 7,000 feet down
The cracks release the gas that powers your town
That well is fracked….. Yeah totally fracked

But there's more in the water than just H2O
Toxic chemicals help to make the fluid flow
With names like benzene and formaldehyde
You better keep 'em far away from the water supply

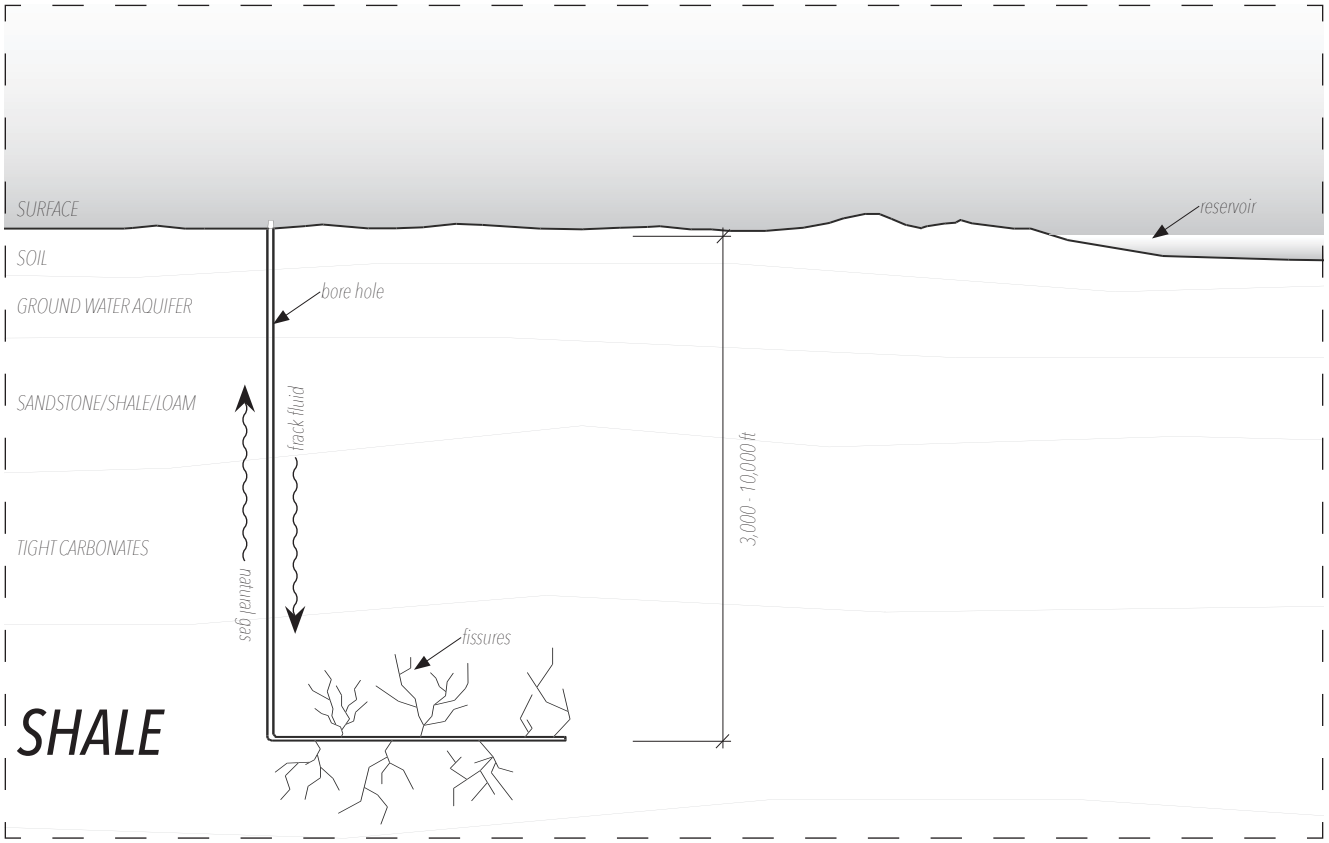
What the frack is going on with all this fracking going on
I think we need some facts to come to light
I know we want our energy but nothing ever comes for free
I think my water's on fire tonight

THE GEOLOGY

Hydrofracking is reliant on natural shale formations, a finely grained sedimentary rock which contains minute deposits of natural gas and oil. Typically, shale would form at the bottom of deep, slow moving bodies of water, such as lakes or inland seas, where no oxygen was present. As zooplankton and other organisms died, they would be deposited at the bottom of the water to eventually be covered by more sediment.[10] Overtime, this leads to a process called compaction, during which the pressure of the matter above generates enough heat to turn the organic matter into fossil fuels. Today, that fossil fuel is anywhere from 3 to 15 miles below the earth's crust.

Much of the shale in the continental United States formed under the Western Interior Seaway beginning in the Devonian period (Figure 11).[11] The fracking process is limited geographically by the location of shale formations, shown in Figure 12.

FIGURE 11



10. Prud'homme, A. (2014). *Hydrofracking: What Everyone Needs to Know*. New York, NY: Oxford University Press.

11. Appendix: B

FIGURE 11
Gibson, Richard. "Sevier Orogeny." History of the Earth. November 22, 2014. http://historyoftheearthcalendar.blogspot.com/2014_11_01_archive.html.

FIGURE 12
Prud'homme, A. (2014). *Hydrofracking: What Everyone Needs to Know*. New York, NY: Oxford University Press. 4.

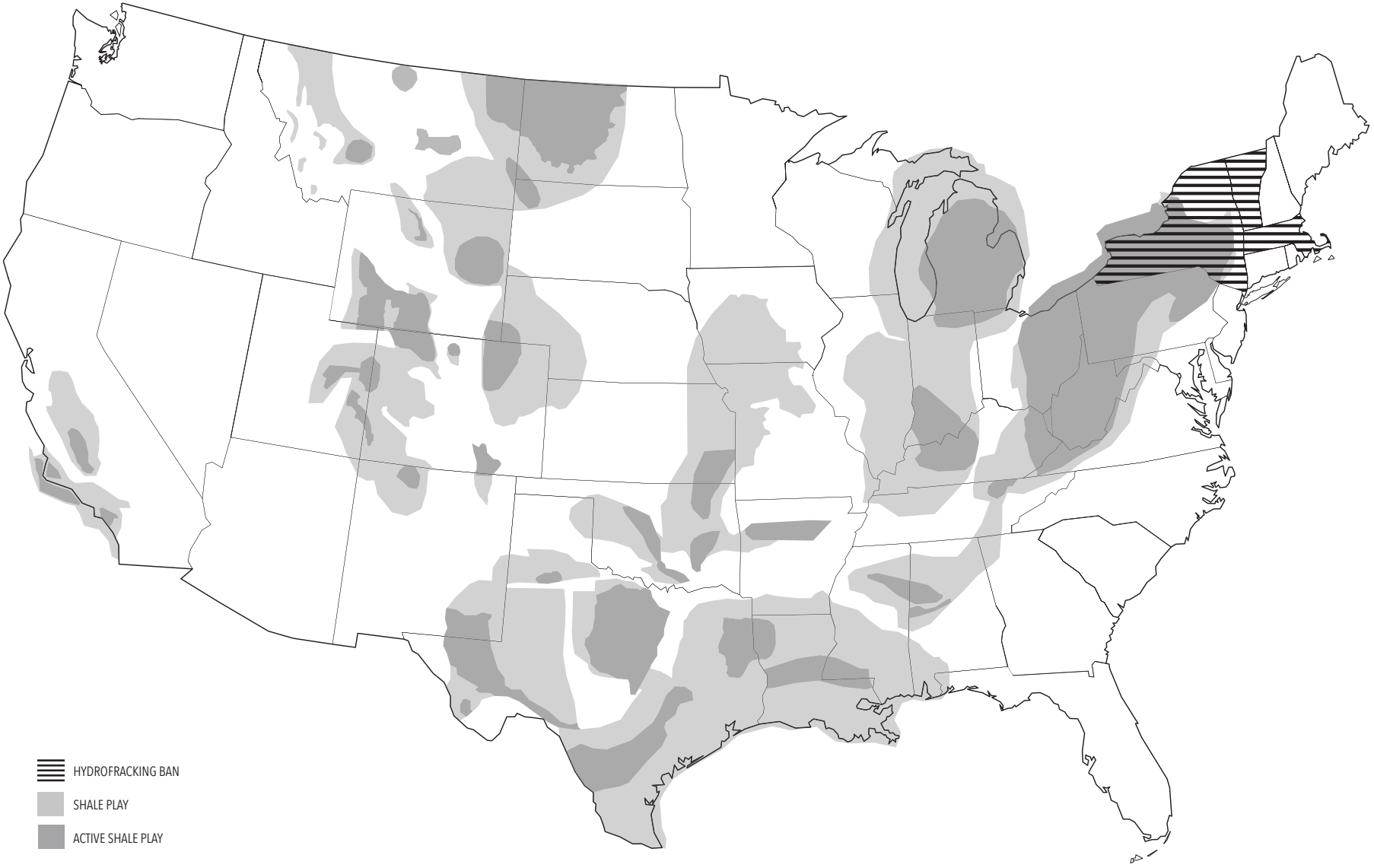
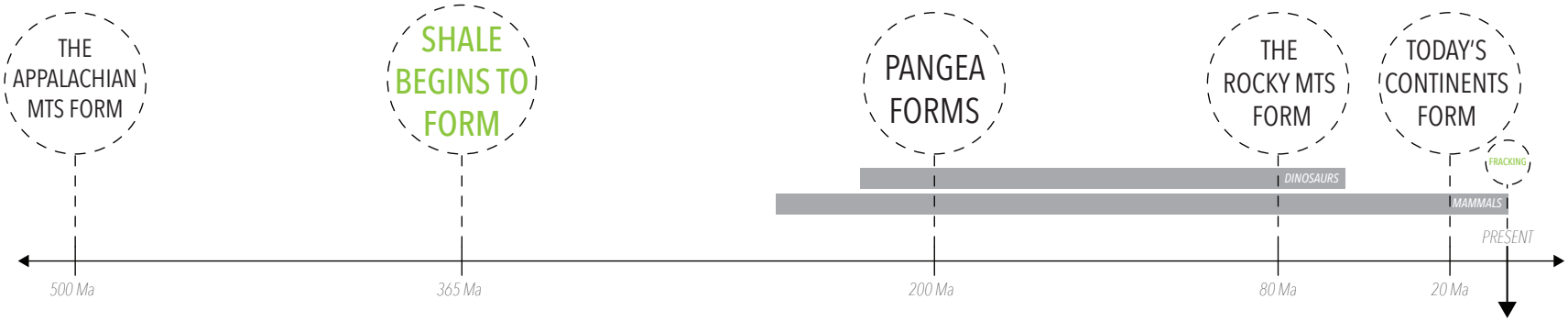


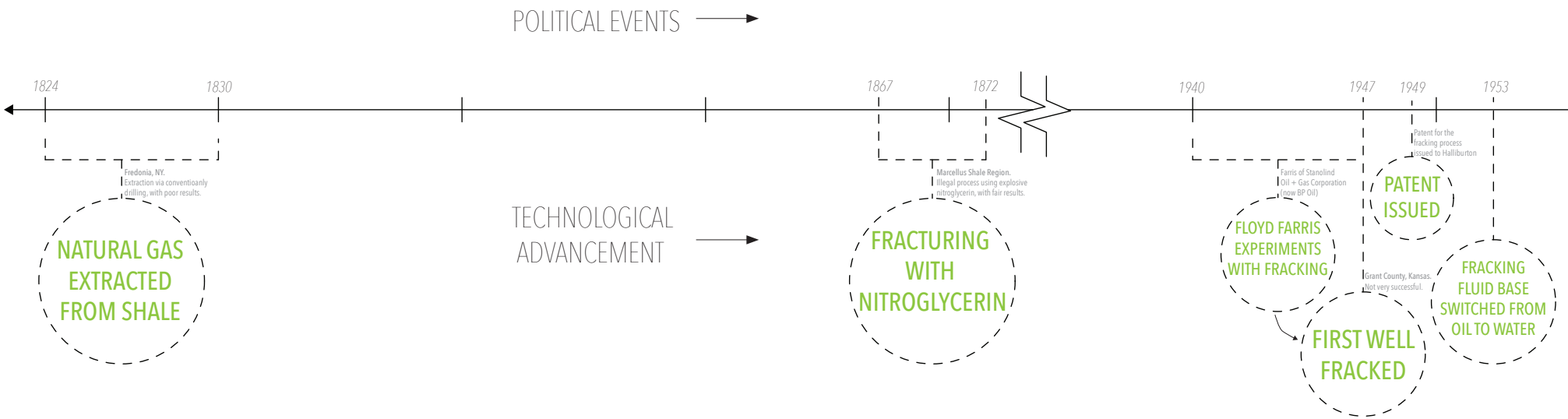
FIGURE 12

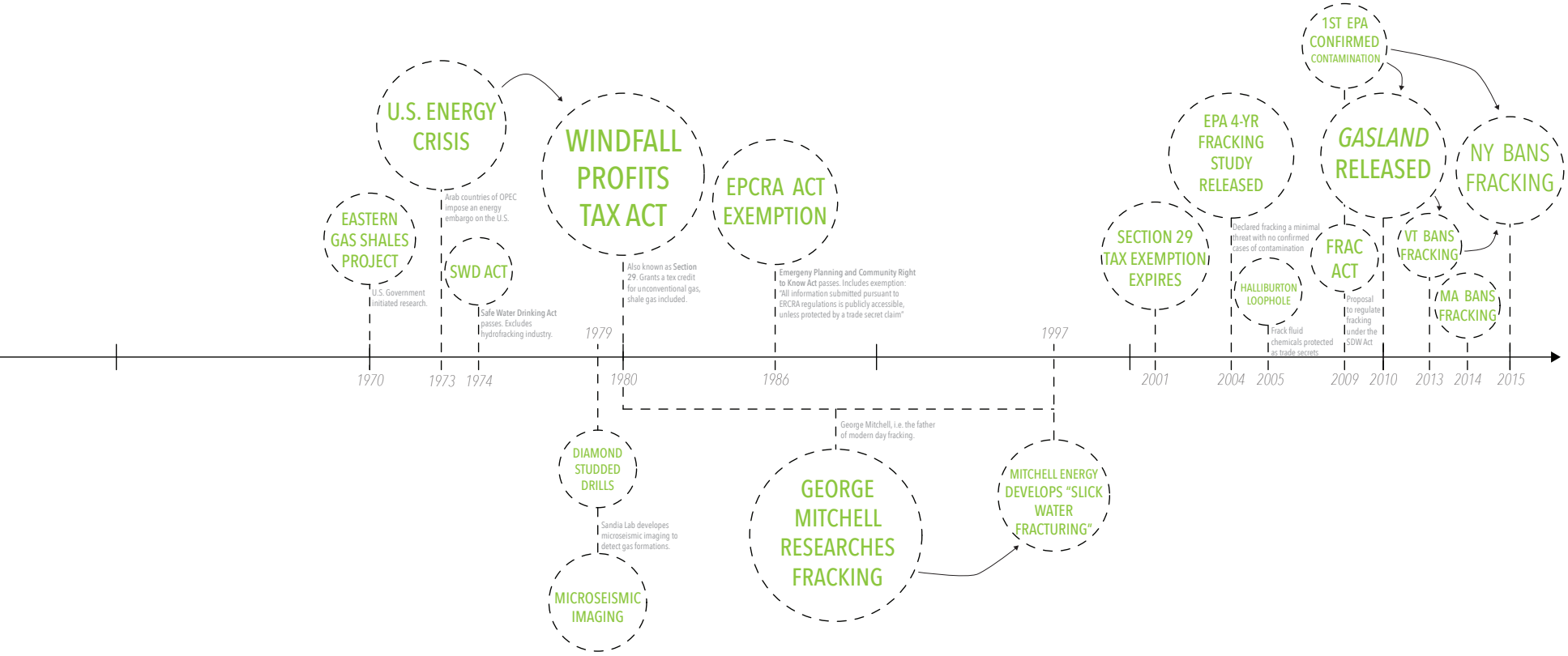
THE HISTORY

GEOLOGICAL



MODERN DAY




1ST EPA CONFIRMED CONTAMINATION
U.S. ENERGY CRISIS
WINDFALL PROFITS TAX ACT
EPCRA ACT EXEMPTION
EPA 4-YR FRACKING STUDY RELEASED
GASLAND RELEASED
NY BANS FRACKING
EASTERN GAS SHALES PROJECT
SWD ACT
SECTION 29 TAX EXEMPTION EXPIRES
FRAC ACT
VT BANS FRACKING
MA BANS FRACKING
HALLIBURTON LOOPHOLE
DIAMOND STUDDED DRILLS
MICROSEISMIC IMAGING
GEORGE MITCHELL RESEARCHES FRACKING
MITCHELL ENERGY DEVELOPS "SLICK WATER FRACTURING"
Arab countries of OPEC impose an energy embargo on the U.S.
U.S. Government initiated research.
Safe Water Drinking Act passes. Excludes hydrofracking industry.
Also known as Section 29. Grants a tex credit for unconventional gas, shale gas included.
Emergeny Planning and Community Right to Know Act passes. Includes exemption: "All information submitted pursuant to ERCRA regulations is publicly accessible, unless protected by a trade secret claim"
Declared fracking a minimal threat with no confirmed cases of contamination
Frack fluid chemicals protected as trade secrets
Proposal to regulate fracking under the SDW Act
Sandia Lab developes microseismic imaging to detect gas formations.
George Mitchell, i.e. the father of modern day fracking.
1970
1973
1974
1979
1980
1986
1997
2001
2004
2005
2009
2010
2013
2014
2015

THE PROCESS

Once shale has been detected in an area through microseismic imaging, gas companies begin to approach local landowners in order to lease or purchase the mineral rights below their properties, which give them the right to frack. Following the acquisition of those rights, the companies set out to build the infrastructure necessary for their process, including the building of temporary housing for rig workers, the drill pads, and the roads for the trucks needed to transport water, gas and equipment.

Hydrofracking begins with the drilling of a vertical well, in the same way as conventional drilling. Once into the shale formation, anywhere from 3 to 15 miles down, the drilling method is altered so the borehole begins to form horizontally, drilling laterally through the shale. The well is then dried, cleaned, and cased in altering concentric rings of steel and cement. Once sealed this way, 400,000 gallons of fracking fluid is injected at pressures upwards of 15,000 psi, causing the shale to fracture and release the previously trapped natural gas, which is then free to flow to the surface when the pressure is revered.[12] This is considered one completion, or one "frack"; typically a well is fracked 18 times in its lifespan.

On average, only 30% of the frack fluid returns to the surface during this process. The rest goes unaccounted for below ground, which gives cause for concern due to the make-up of the fluid - 99% water and sand, and 1% unknown hazardous chemicals.[13] Flowback water then needs to be either transported and treated or stored on site, which is often done in either "lagoons" which then allow the water-chemical mixture to evaporate, or by injecting it into underground repositories.[14]

The entire process from setup of the drill pad to the end of the first completion takes approximately 4 months.

12. "Hydro-fracking." The Cooper Union. http://cooper.edu/isd/projects/energy/natural-gas/hydro-fracking#/gallery/1.

13. Prud'homme, A. (2014). *Hydrofracking: What Everyone Needs to Know*. New York, NY: Oxford University Press.

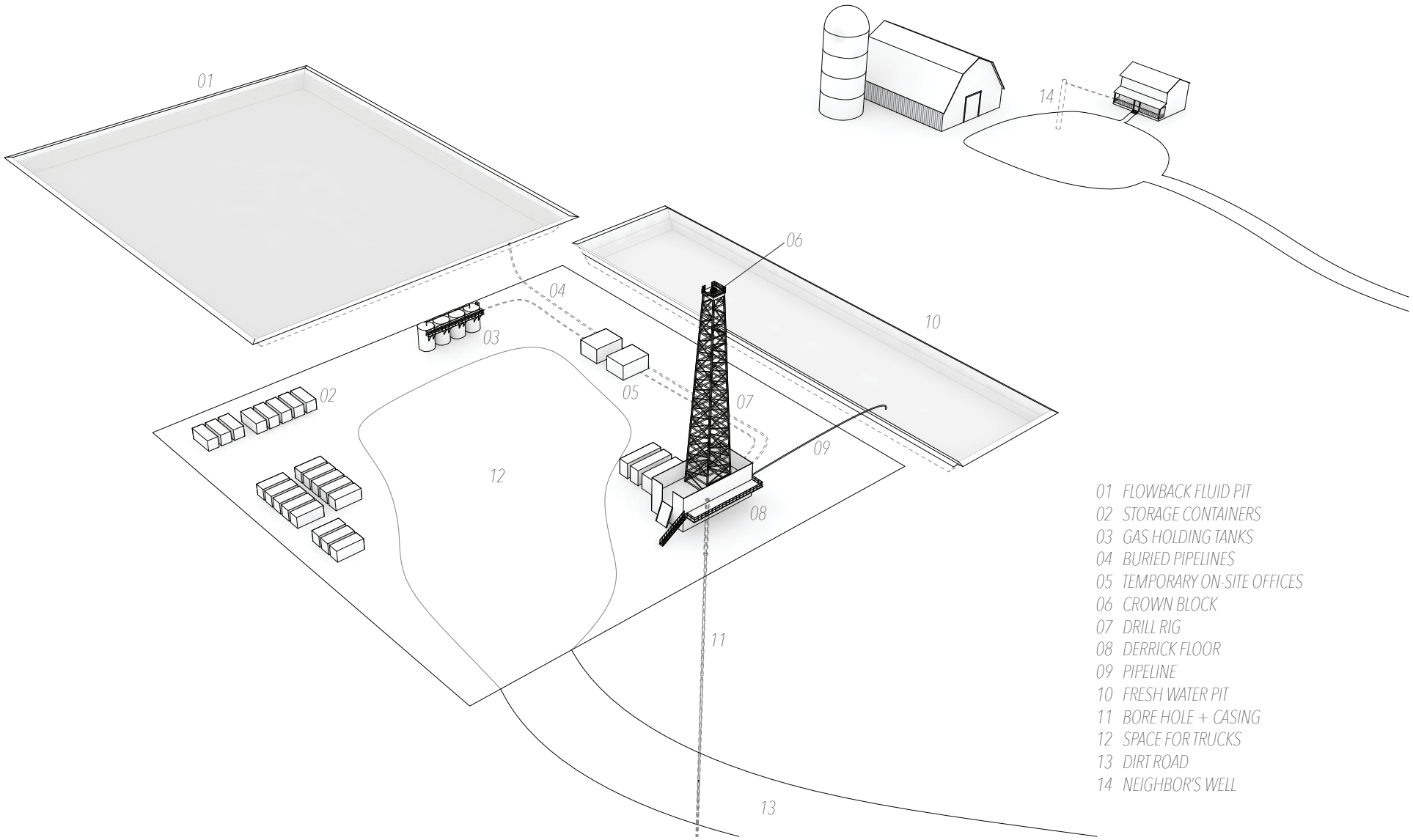
14. "Hydro-fracking." The Cooper Union. http://cooper.edu/isd/projects/energy/natural-gas/hydro-fracking#/gallery/1.

FIGURE 13

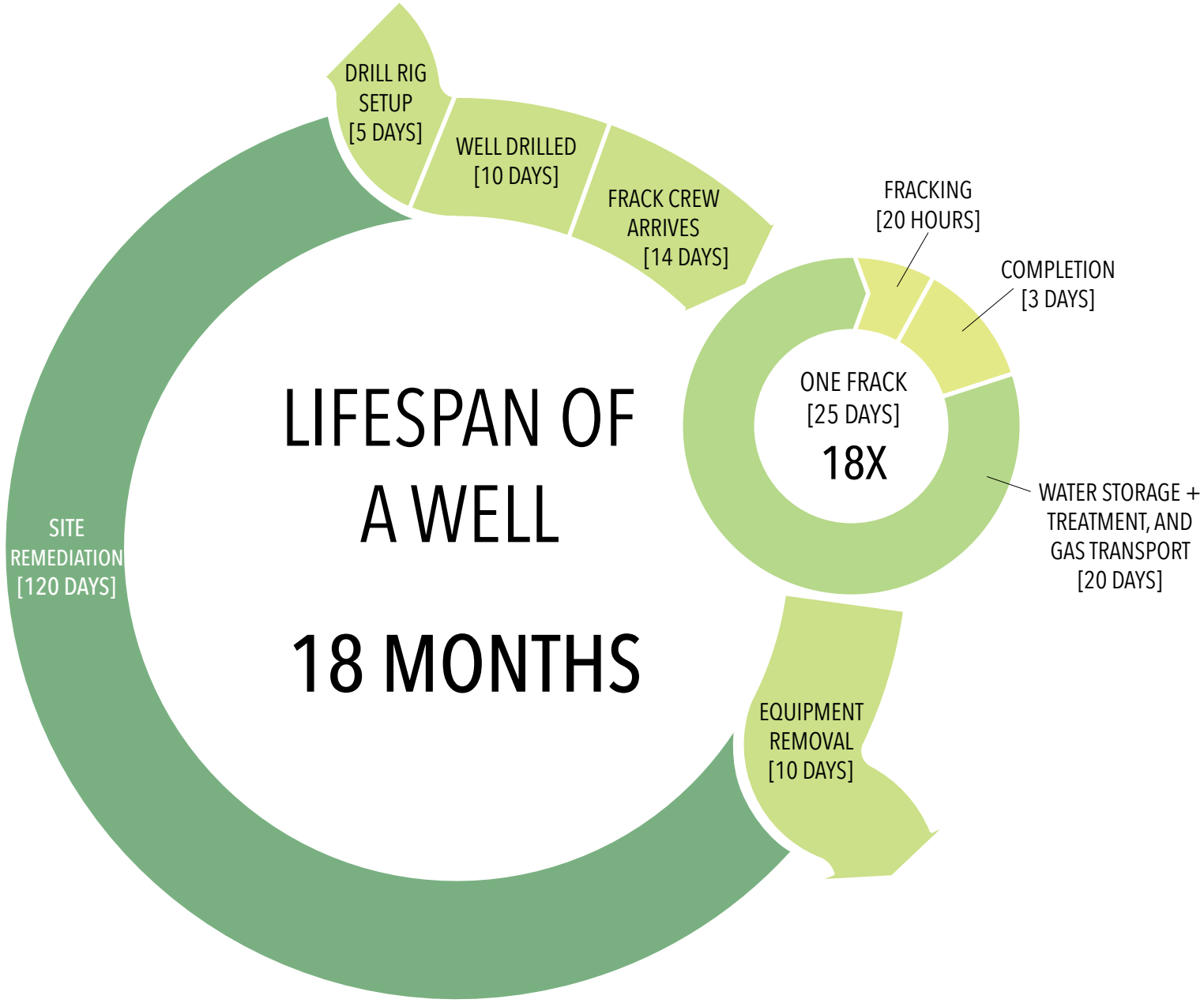
FIGURE 14

FIGURE 13
"No Fracking In New York? That's OK With Pennsylvania." WWNO: New Orleans Public Radio. December 18, 2014. http://wwno.org/post/no-fracking-new-york-thats-ok-pennsylvania.

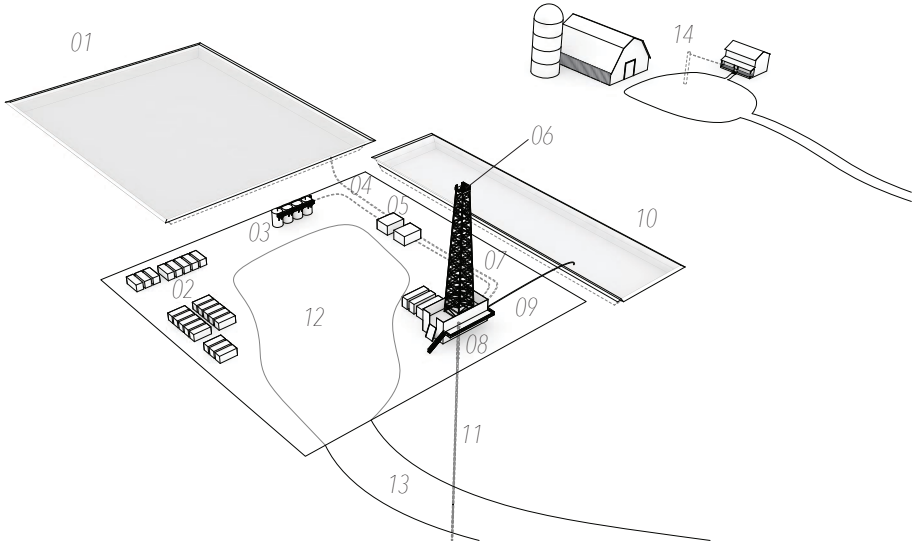
FIGURE 14
Thomas, Madeleine. "With Eyes in the Sky, Researchers Try to Link Fracking and Illness." Grist. November 14, 2014. http://grist.org/list/with-eyes-in-the-sky-researchers-try-to-link-fracking-and-illness/.



01 FLOWBACK FLUID PIT
02 STORAGE CONTAINERS
03 GAS HOLDING TANKS
04 BURIED PIPELINES
05 TEMPORARY ON-SITE OFFICES
06 CROWN BLOCK
07 DRILL RIG
08 DERRICK FLOOR
09 PIPELINE
10 FRESH WATER PIT
11 BORE HOLE + CASING
12 SPACE FOR TRUCKS
13 DIRT ROAD
14 NEIGHBOR'S WELL

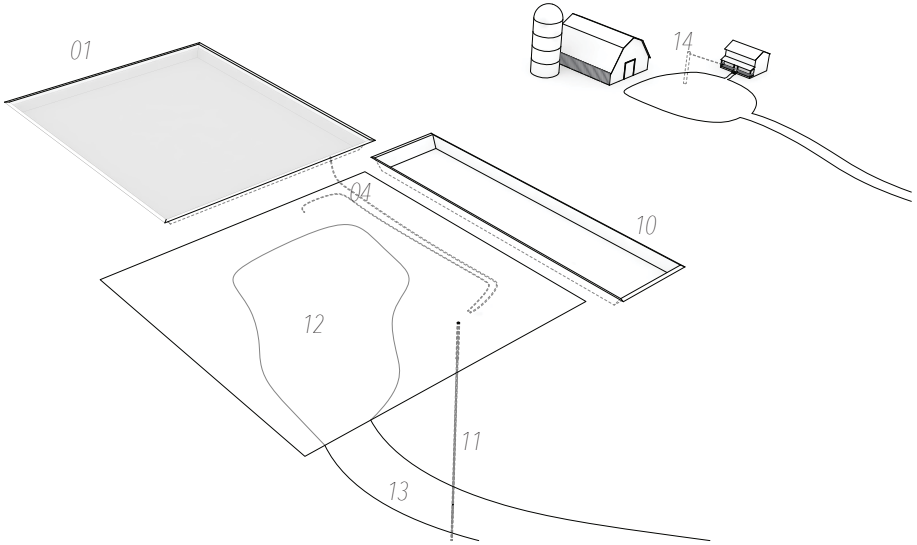

DRILL RIG SETUP [5 DAYS]
WELL DRILLED [10 DAYS]
FRACK CREW ARRIVES [14 DAYS]
FRACKING [20 HOURS]
COMPLETION [3 DAYS]
ONE FRACK [25 DAYS]
18X
WATER STORAGE + TREATMENT, AND GAS TRANSPORT [20 DAYS]
EQUIPMENT REMOVAL [10 DAYS]
SITE REMEDIATION [120 DAYS]
LIFESPAN OF A WELL
18 MONTHS

DURING

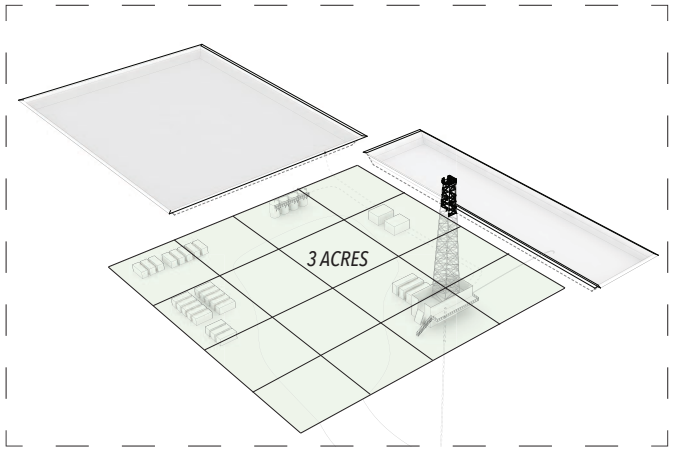


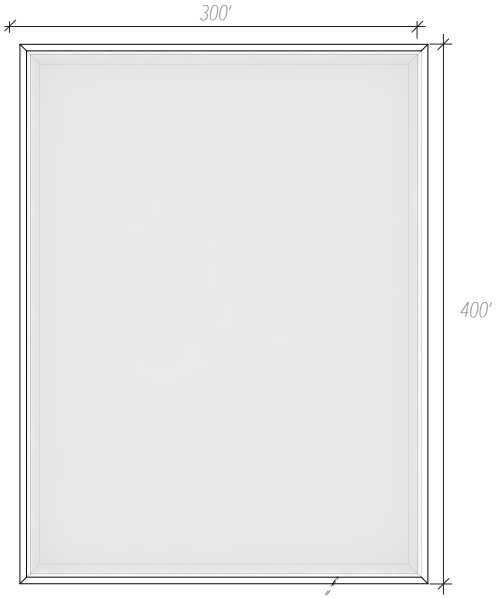
01 FLOWBACK FLUID PIT
02 STORAGE CONTAINERS
03 GAS HOLDING TANKS
04 BURIED PIPELINES
05 TEMPORARY ON-SITE OFFICES
06 CROWN BLOCK
07 DRILL RIG
08 DERRICK FLOOR
09 PIPELINE
10 FRESH WATER PIT
11 BORE HOLE + CASING
12 SPACE FOR TRUCKS
13 DIRT ROAD
14 NEIGHBOR'S WELL

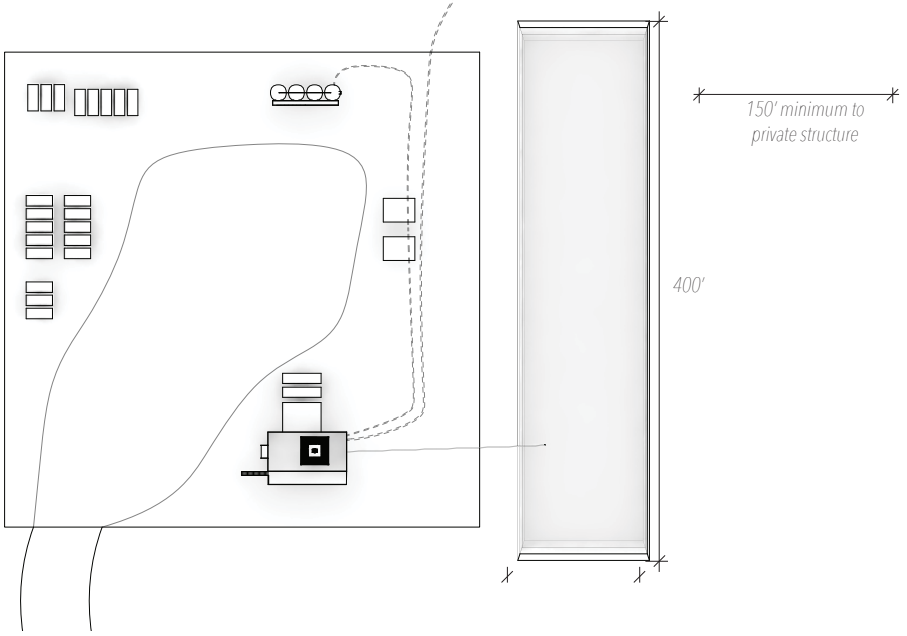
AFTER

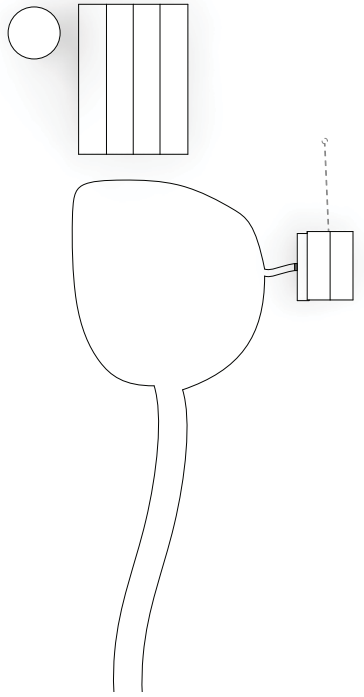


01 FLOWBACK FLUID PIT
02 STORAGE CONTAINERS
03 GAS HOLDING TANKS
04 BURIED PIPELINES
05 TEMPORARY ON-SITE OFFICES
06 CROWN BLOCK
07 DRILL RIG
08 DERRICK FLOOR
09 PIPELINE
10 FRESH WATER PIT (EMPTY)
11 BORE HOLE + CASING
12 SPACE FOR TRUCKS
13 DIRT ROAD
14 NEIGHBOR'S WELL

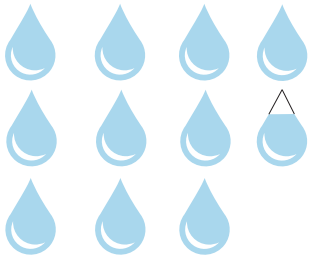

3 ACRES


300'
400'


150' minimum to
private structure
400'



WATER PER FRACK



= WATER USE PER
1 AMERICAN, PER YEAR
[37,000 GALLONS]

CARBON EMISSIONS PER WELL

= CARBON EMISSIONS
FOR WIND POWER

WATER TANKERS NEEDED FOR TRANSPORT

= BRINGING WATER TO SITE

= TAKING CONTAMINATED WATER AWAY FOR REMEDIATION

ENVIRONMENTAL IMPACT STATISTICS

WATER STATISTIC
"Gallons Used per Person per Day." USGS. http://www.phila.gov/water/educationoutreach/Documents/Homewateruse_IG5.pdf.

"Hydro-fracking." The Cooper Union. http://cooper.edu/isd/projects/energy/natural-gas/hydro-fracking#/gallery/1

CARBON STATISTIC
"Greenhouse Gas Emissions Avoided through Use of Nuclear Generation." World Nuclear Association.

TANKER TRUCK STATISTIC
"How Many Gallons Does a Tanker Truck Hold?" Ask.com. http://www.ask.com/.

Prud'homme, A. (2014). *Hydrofracking: What Everyone Needs to Know*. New York, NY: Oxford University Press.

THE CONTROVERSY

Although modern day fracking has been going on since the late 1990's, the issue has only truly caught the attention of the public since 2009, gaining much of its momentum in 2010 after the release of Josh Fox's documentary *Gasland* (Figure 15). Since that time, many local counties have banned the practice, as well as the states of Vermont (2013), Massachusetts (2014), and New York (2015). The issue is in the process of also taking an international stage, with protests around the world, and a national ban in France.

While hydrofracking offers enough fuel for the next hundred years, jobs, economic reprieve for struggling communities, and a relatively clean source of energy as compared to coal or oil, the general public's concerns lie in the process's potential for contamination of water supplies, soil, food sources, and air. The Halliburton Loophole allows companies to withhold the list of chemicals added to fracking fluid, 70% of which is lost underground and has been known to pollute wells and aquifers. In the process, methane is also stirred underground, which then seeps into water supplies, resulting in the infamous "water on fire" effect (Figure 16), or exploding wells. More troubling, the fracking industry is exempted from the Safe Drinking Water Act, and is highly under regulated by the EPA.

Researchers have been able to link cases of sickened or killed livestock with hydrofracking as well, but are impeded by the Halliburton Loophole and nondisclosure agreements.[15] Studies are currently being conducted to prove the adverse effects of the process on humans, but as of today there are only anecdotal cases of people becoming sick due to accidents on the part of the gas companies. Very little is understood about the true effects of the process in the long term, and as public opinion has sifted towards opposing fracking, politicians are under increasing pressure.

FIGURE 15
"Yakov Chernikhov." VisualizeUs. http://vi.sualize.us/yakov_chernikhov_constructivism_architectural_fantasy_picture_3X9g.html.

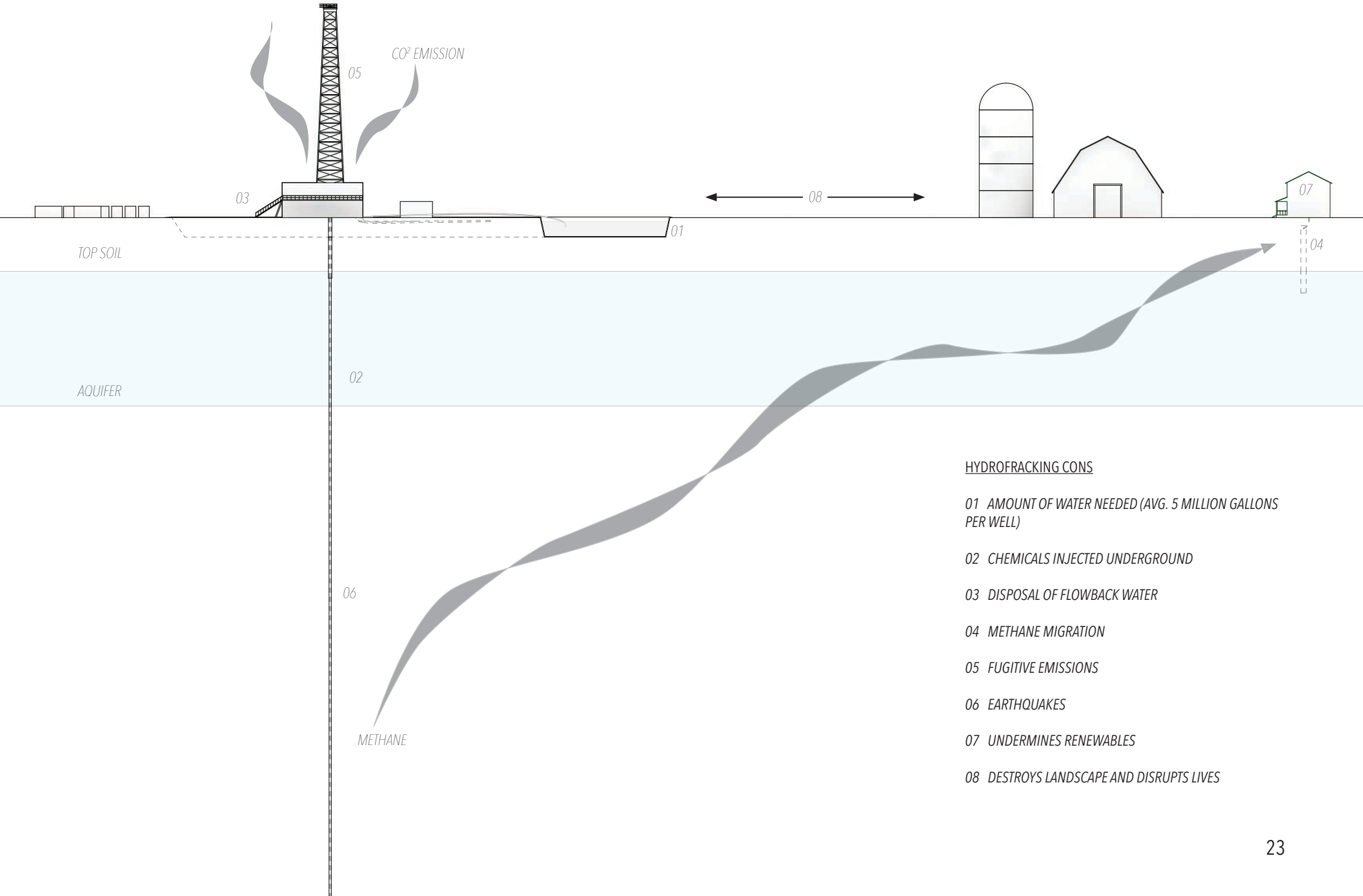
FIGURE 16
Still frame. *Gasland*. YouTube, 2010. Film.

FIGURE 17
"Living in His World: Antonio Sant'Elia 1888-1916." Core77. http://www.core77.com/posts/18159/Living-in-his-world-Antonio-SantElia-1888-1916.

FIGURE 15

FIGURE 16

FIGURE 17



HYDROFRACKING CONS

01 AMOUNT OF WATER NEEDED (AVG. 5 MILLION GALLONS PER WELL)

02 CHEMICALS INJECTED UNDERGROUND

03 DISPOSAL OF FLOWBACK WATER

04 METHANE MIGRATION

05 FUGITIVE EMISSIONS

06 EARTHQUAKES

07 UNDERMINES RENEWABLES

08 DESTROYS LANDSCAPE AND DISRUPTS LIVES

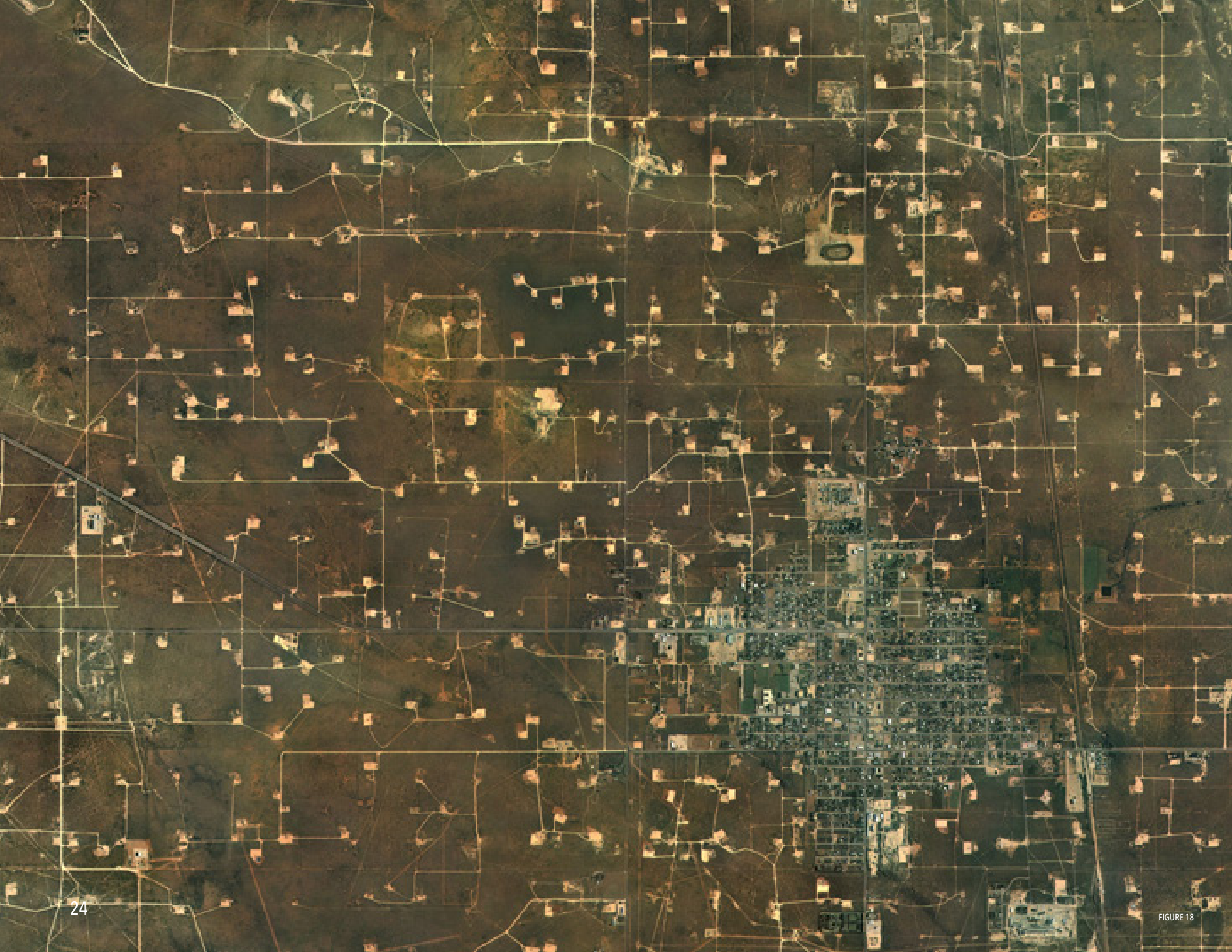


FIGURE 18

TOXIC SUBLIMITY

The term Sublime in the philosophy of aesthetics refers to that which affects "the mind with a sense of overwhelming grandeur or irresistible power - calculated to inspire awe, deep reverence, or lofty emotion, by reason of its beauty, vastness, or grandeur."[15] Originally used to describe terrifying parts of nature, but today the sublime often refers to visual realizations of human triumph over nature or human caused desecration. Images like "Nickel Tailings #34" by Edward Burtynsky (Figure 21) hold a certain amount of power over their viewer - they evoke feelings of both awe and horror at human destructive power - otherwise known as the toxic sublime.

The way that hydrofracking, and the roads necessary to connect the pads carve up the landscape (Figure 18) and then polluted the soil and water make the visual representations of fracking toxically sublime. "Collaborating with Catastrophe" pushes the limits of this toxicity, giving the project more potential to act as a catalyst in the spirit of a jeremiad.

15. Oxford English Dictionary

FIGURE 18
"Hydro-fracking." The Cooper Union. http://cooper.edu/isd/projects/energy/natural-gas/hydro-fracking#/gallery/1.

FIGURE 19
"Interpreting the Sublime." Sublimityofnature. September 12, 2012. https://livinthe-life12.wordpress.com/interpreting-the-sublime/.

FIGURE 20
"Golden Gate Bridge and Winter Fog." Vern Clevenger: Gallery of Fine Photography. https://www.vernclevenger.com/site/catalog-index/images/11-1.

FIGURE 21
"Nickel Tailings #34." EDWARD BURTYNSKY. 1996. http://www.edwardburtynsky.com/.

The NATURAL Sublime
- Edmund Burke (c. 1756)

FIGURE 19

The TECHNOLOGICAL Sublime
- David Nye (c. 1994)

FIGURE 20

The TOXIC Sublime
- Edward Burtynsky (c. 1983)
- Jennifer Peeples (c. 2011)

FIGURE 21

2030 AD.

10^{6} - THE CONTINENT
10^{4} - THE COUNTY
10^{3} - THE FARM [*THE SITE*]
10^{-1} - THE SOIL

Beck, Ulrich. Risk Society towards a New Modernity. London: Sage Publications, 1992.

"[Toxins and pollutants] generally remain invisible, are based on causal interpretations, and thus initially only exist in terms of the knowledge about them. They can thus be changed, magnified, dramatized or minimized within knowledge, and to that extent they are particularly open to social definition and construction"

2030 AD.
INTRODUCTION

"Collaborating with Catastrophe" is operating as a jeremiad, examining modern day society's choice to ignore the warning signs of global warming by resisting the life style changes that scientists warn are necessary. The platform from which this thesis jumps is the harsh process of hydrofracking, and its overlap with agrarian communities - pulling at the juxtaposition of food source and fuel source, one which needs water and soil, and one which pollutes water and soil. A jeremiad relies on a prophecy of a catastrophic future, in this case caused by hydrofracking amongst other environmentally degrading processes, and as such is by definition set in a future time.

This thesis is set in the year 2030, a year for which scientists have a large base of climate predictions, but which is not so far into the future that life is completely unimaginable. Hypothetically, sea levels have risen, natural disasters and wars for resources have lead to a massive population decline, and water and fuel are scarce.

In order for the narrative of the prophecy to be told through architecture, the world of 2030 first must be understood at a range of scales, in order to give context, legitimacy, and meaning to the eventual final prophecy design. In the context of Charles and Ray Eames's film *Powers of Ten*, the key scales that this thesis casts predictions for are 10^{6}, 10^{4}, and 10^{-1}, or in other terms, the scale of the Continent, the County, and the Soil. With the future world then understood at those levels, the design project then occurs at 10^{3}, or the scale of the Farm.[16]

At that final scale, the questions proposed are how is agriculture forced to operate in a post-apocalyptic 2030? What is able to grow? How is water and other resources attained? And how is all of this overlapping with the hydrofracking, which is still predicted to be occurring?

16. *Powers of Ten*. Directed by Charles Eames and Ray Eames. Pyramid Film & Video, 1977. Film.

17. *"U.S. and Global Temperature." Climate Change Indicators in the United States. http://www3.epa.gov/climatechange/science/indicators/weather-climate/temperature.html.*

FIGURE 22
Powers of Ten. Directed by Charles Eames and Ray Eames. Pyramid Film & Video, 1977. Film.

FIGURE 23
"Earth Modeling Branch (EMB)." Rapid Update Cycle (RUC). http://ruc.noaa.gov/.

FIGURE 24
"Future Climate Change." EPA..http://www3.epa.gov/climatechange/science/future.html#increasinggreenhouse gas.

FIGURE 22

10^6 - THE CONTINENT

A CHANGING COASTLINE

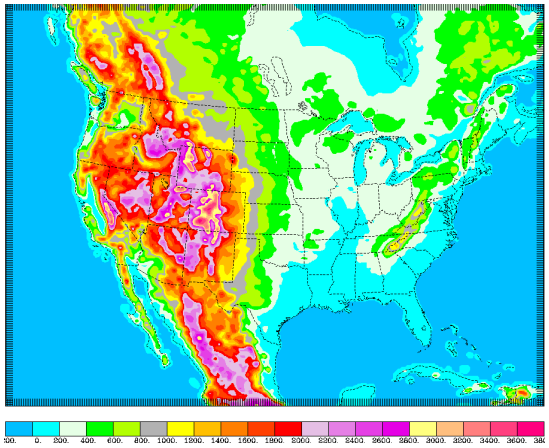


FIGURE 23

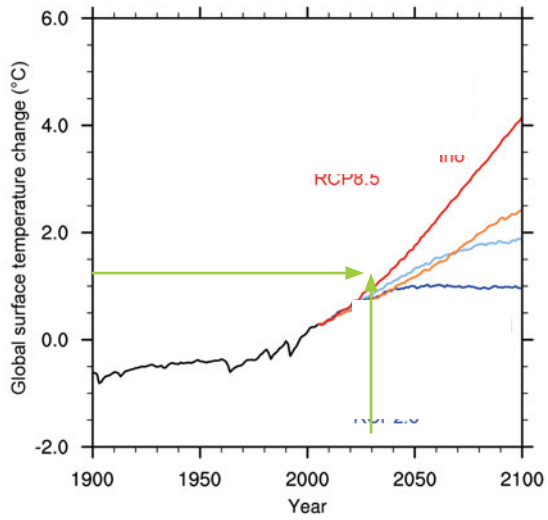
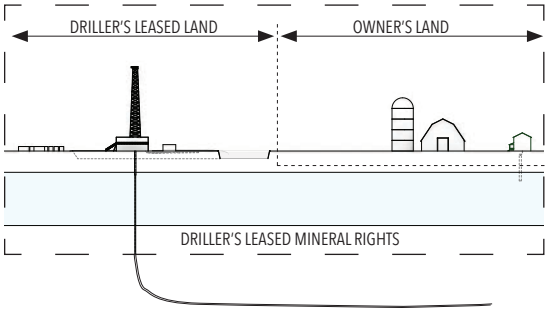


FIGURE 24

The map above illustrates the new coastline predicted by scientists by the year 2030 if the average global temperature rises between 1 and 2 degrees Celsius, as it is expected to.[17] This map is based on the land elevation of the continental U.S. (Figure 23) and the estimates of global warming based on current trends (Figure 24).

In present day, this sea level change would displace hundreds of millions of people in America alone.

FARM/FRACK OVERLAP - A NATION



There is a high concentration of farms over the Marcellus Shale (W. Virginia north to New York) and the Barnett Shale (Texas + Louisiana).

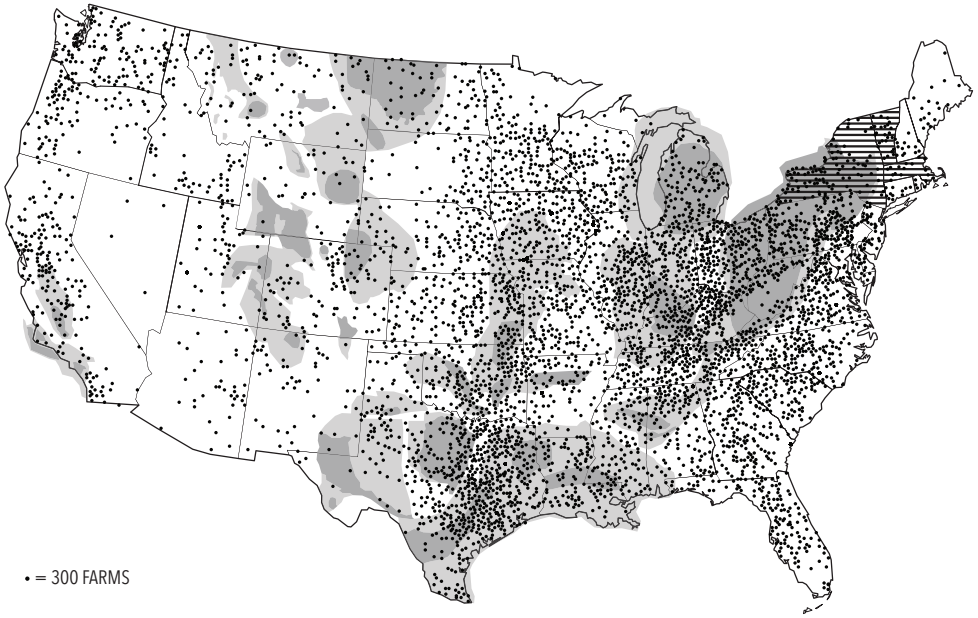
Farmers are usually the first the oil and gas companies approach about leasing land and mineral rights. Economically, independent farmers are very unstable, relying heavily on sources of income outside of the farm, and so the contract offers meet with a high success rate.

Yet farming is an industry that would be extremely affected if hydrofrackings effects were found to be worst case scenario.

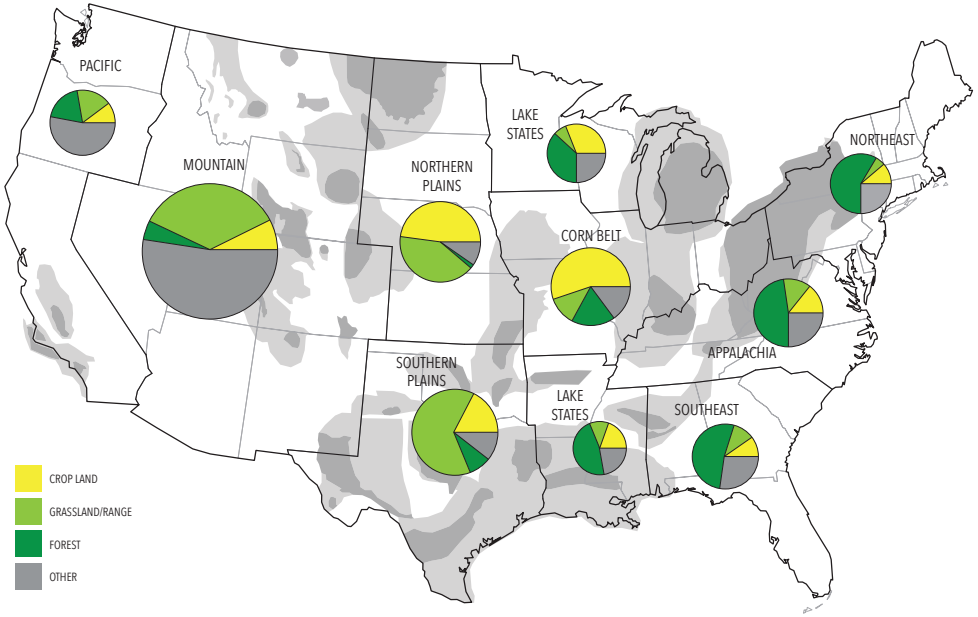
POTENTIAL SHALE PLAY

ACTIVE SHALE PLAY

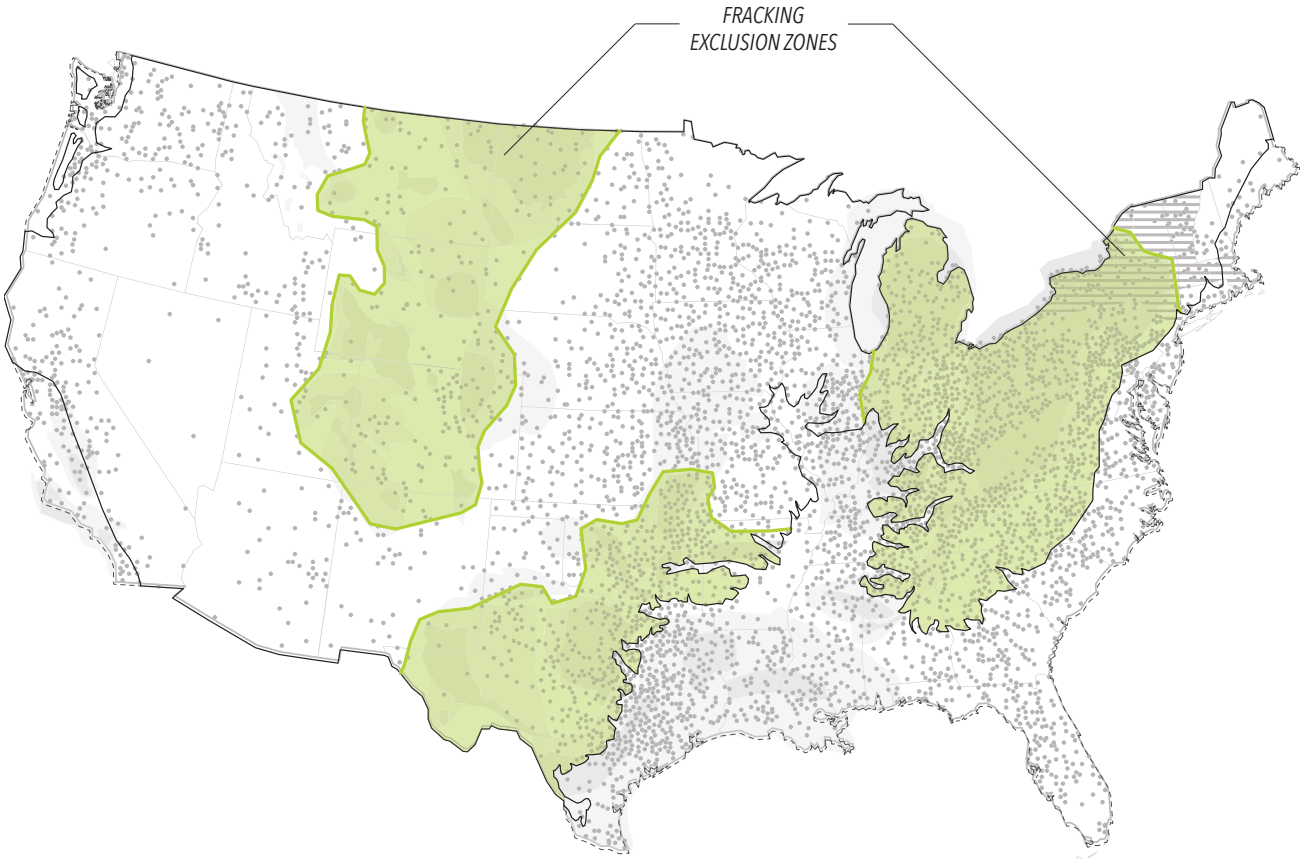
FARMING EPICENTERS

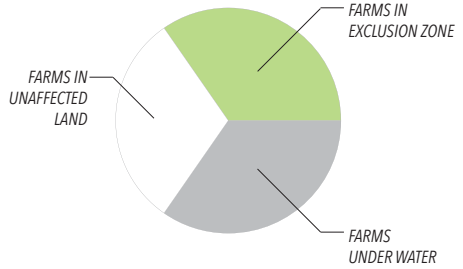


LAND USE



EXCLUSION ZONE FARMING





FARMING EPICENTER MAP
U.S. Department of Agriculture. National Agriculture Statistics Service. 2007.

LAND USE MAP
"Land Use Status and Trends 2007." Natural Resources Conservation Service. 2007. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1083124.

FIGURE 25
"Future Climate Change." EPA..http://www3.epa.gov/climatechange/science/future.html#increasinggreenhouse gas.

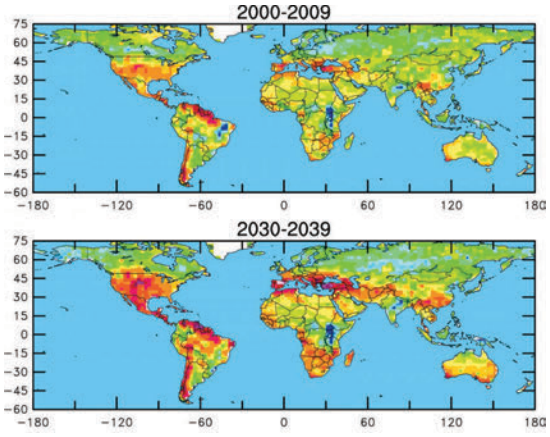


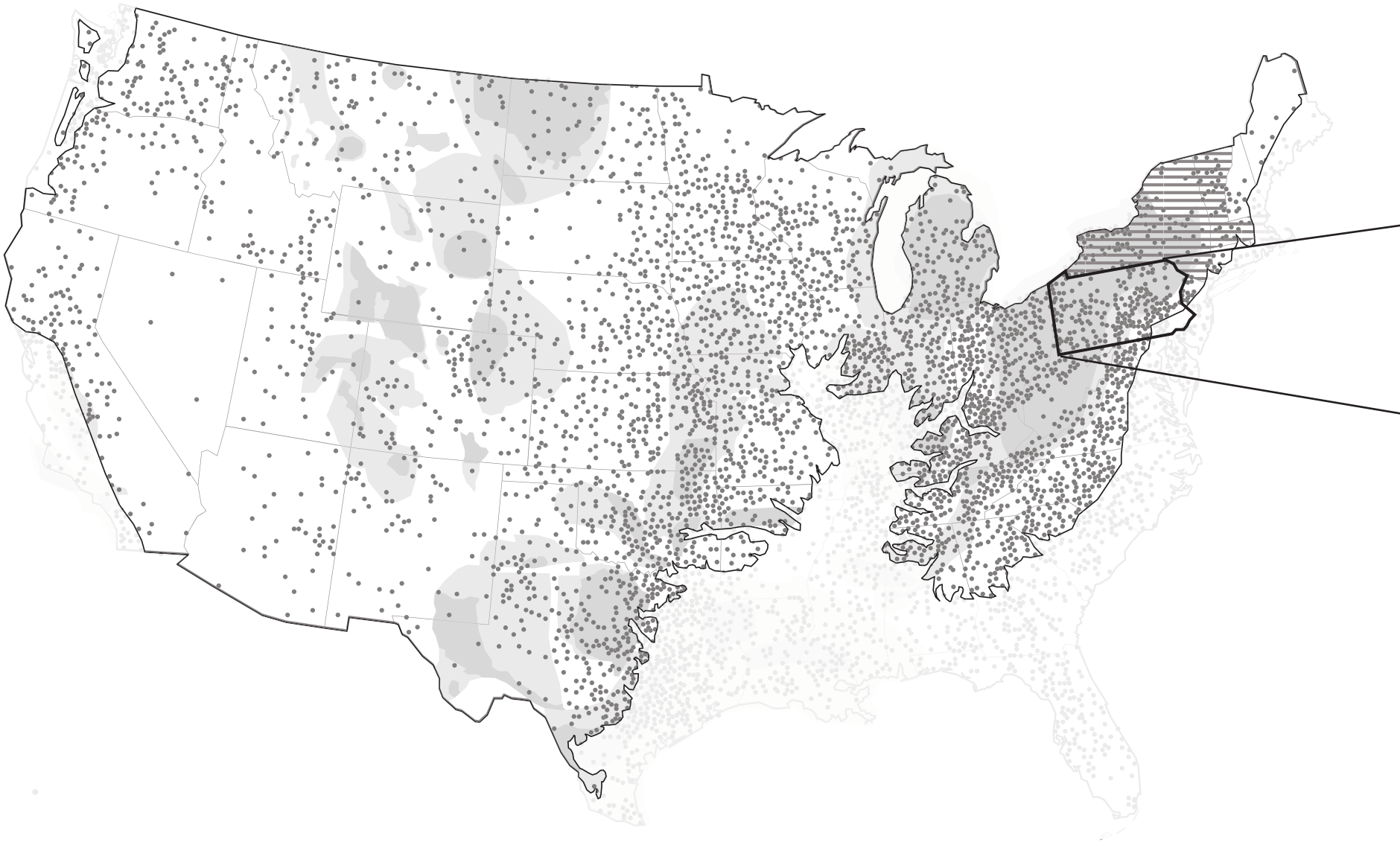
FIGURE 25

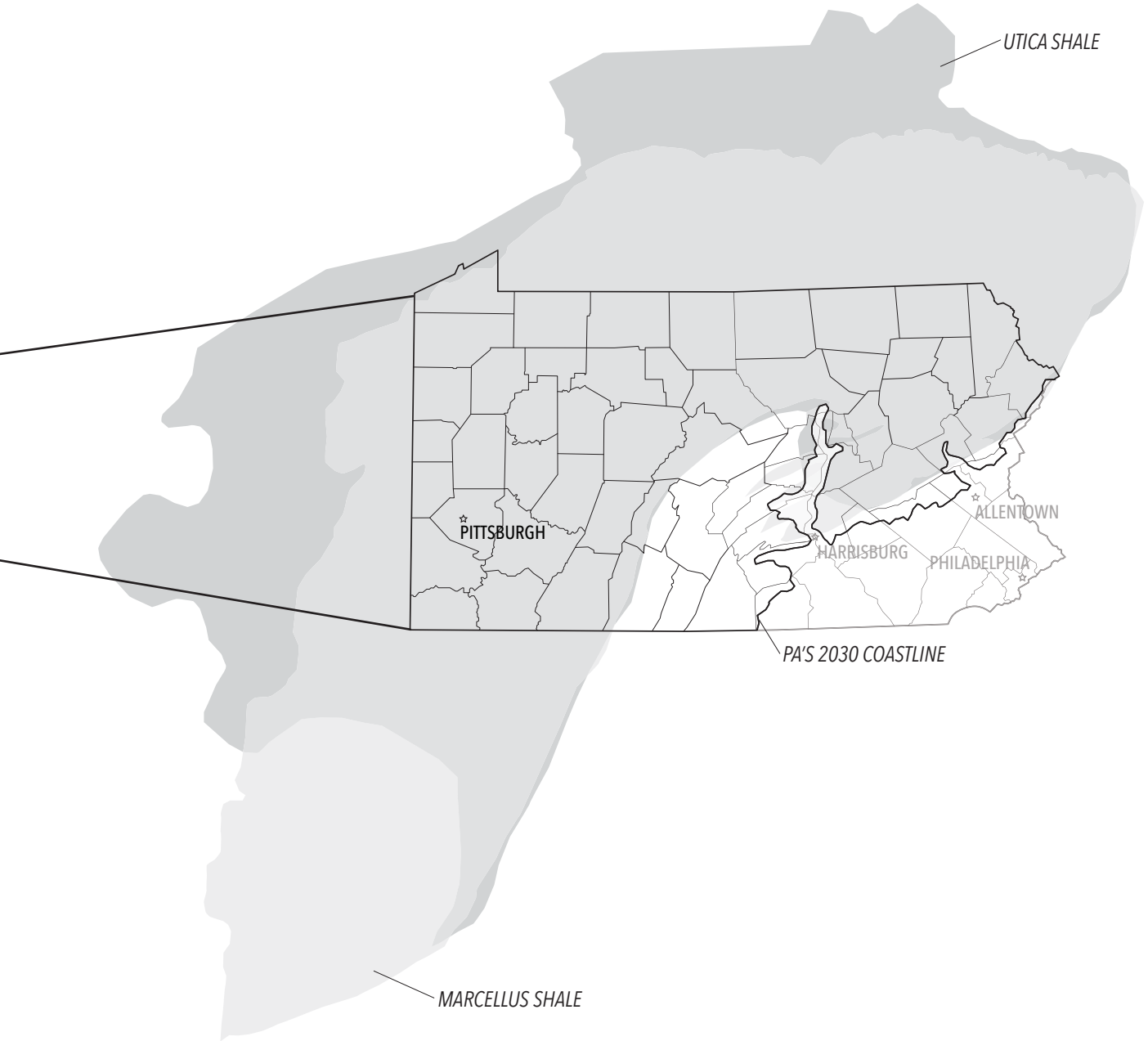
The overlap of farming with hydrofracking becomes more problematic in 2030 when the raised sea levels are considered because it means that a third of what is present day farmland would be submerged underwater, and therefore rendered unproductive. Of the two thirds left, half are located above shale, and therefore in "Collaborating with Catastrophe", are located on detrimentally contaminated land - here represented as "Fracking Exclusion Zones" - a term borrowed from the perimeter set up around Chernobyl, a similarly poised place. But it is feasible that farming would still need to go on in these zones in order to support whatever populations remained, and so it is in these zones that this project resides.

Additionally, it is predicted that fresh water will become a scarce resource, and the U.S. will become increasingly arid (Figure 25), making water collection, conservation, and treatment methods crucial, especially considering the amount fracking demands.

10^4 - THE COUNTY

ZOOMING IN



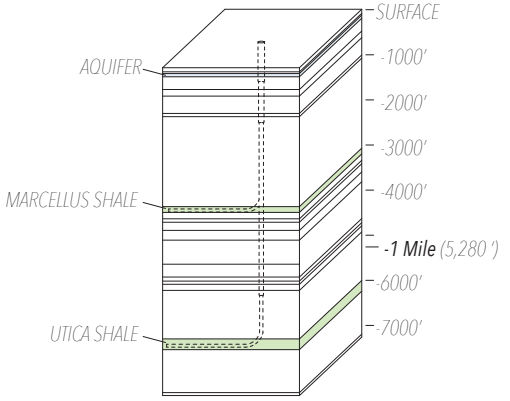


PENNSYLVANIA

Pennsylvania is notoriously one of the leading hydrofracking states. It is also in the middle of one of the most fertile regions of the country, making it a prime.

Additionally, it is richer in shale than almost any other state, with two formations layered above each other. The Marcellus Shale formation lies at a depth of about 6,200 feet, with the Utica Shale formation an additional 3,000 to 7,000 feet below that, and containing oil as opposed to natural gas.[18] This makes the Utica Shale more expensive to frack, as it requires drilling at a much greater depth, but as supplies of fuels become limited, the payoff will be "worth" the cost, meaning that Pennsylvania's fracking industry is no where near it's end. It can thus be assumed that fracking will still be going on here in the year 2030.

18. Prud'homme, A. (2014). *Hydrofracking: What Everyone Needs to Know*. New York, NY: Oxford University Press. 44-45.



FARM/FRACK OVERLAP - A STATE

COUNTIES BY NUMBER OF WELLS

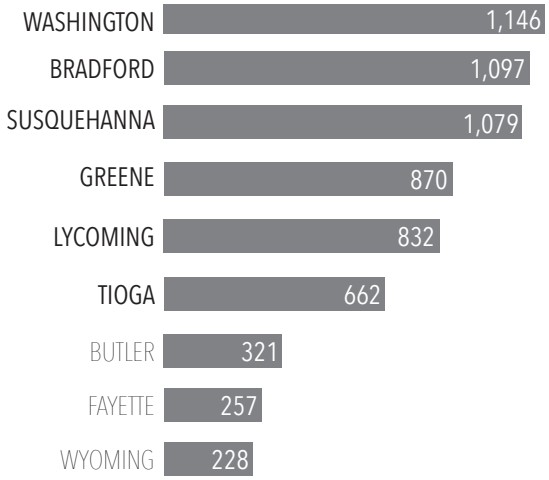
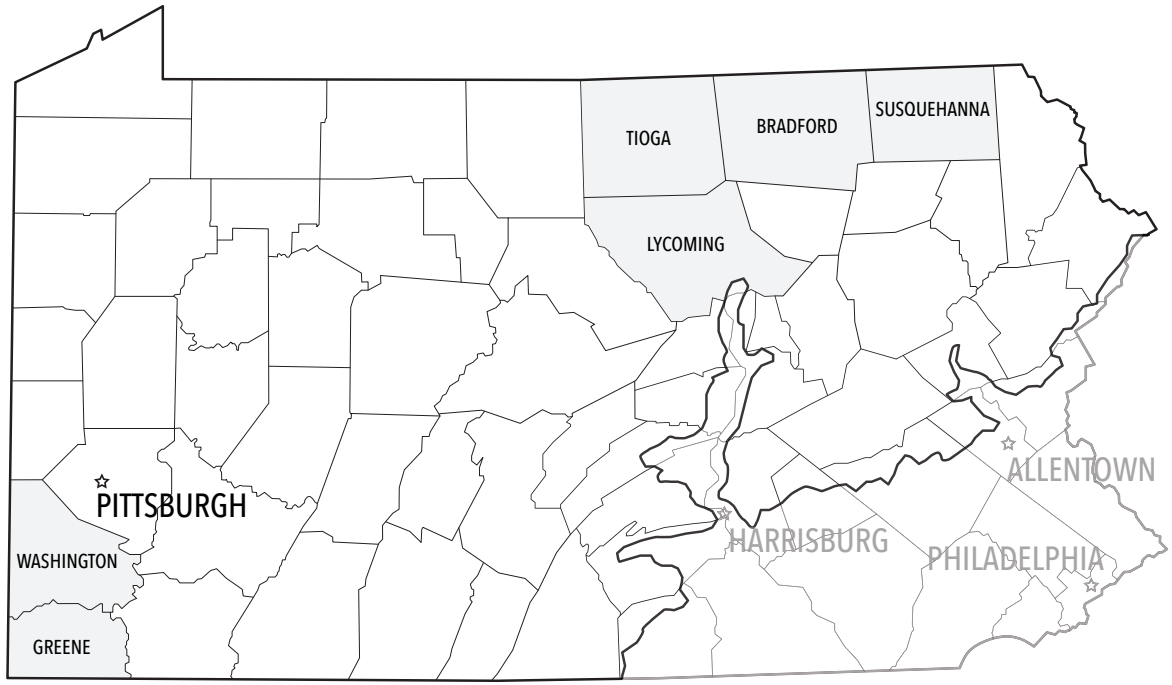
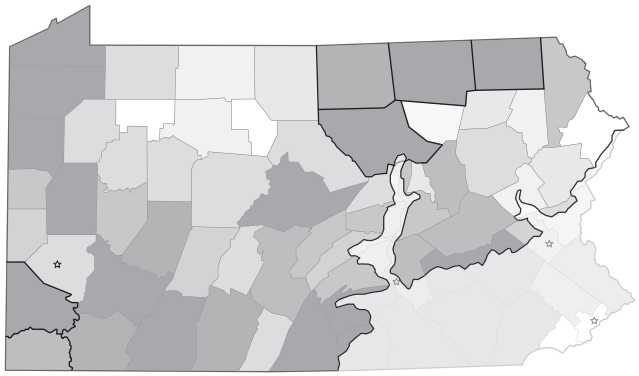


FIGURE 26

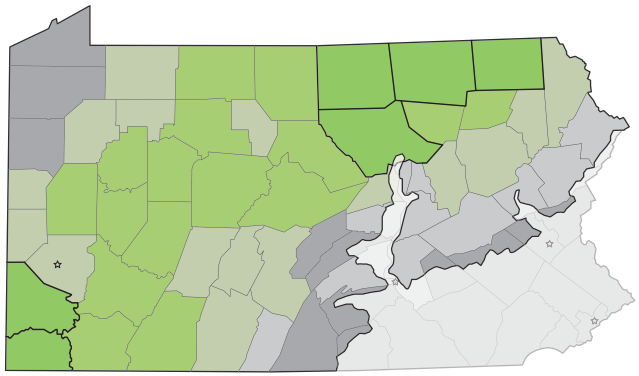


CONCENTRATION OF FARMS

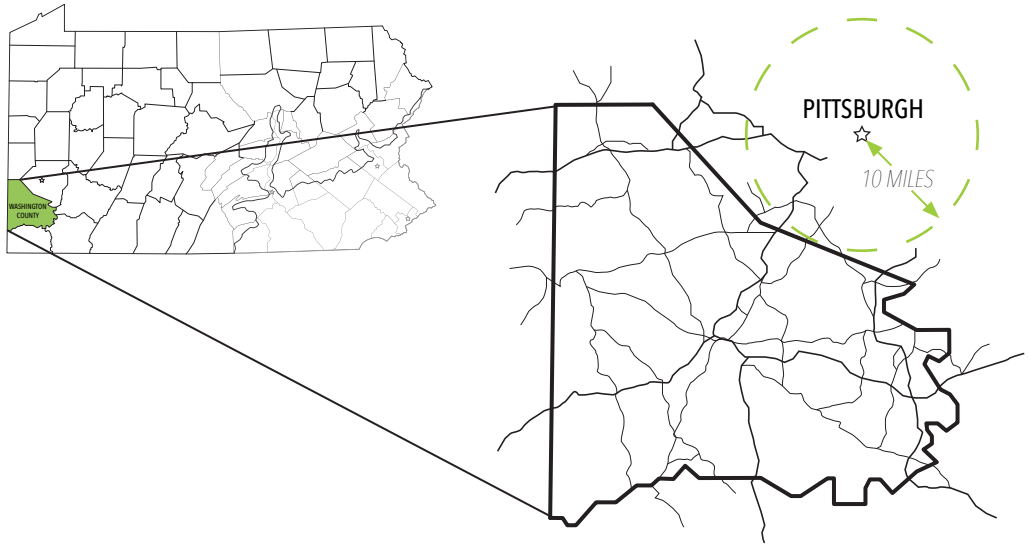


> 1000 | 800 - 899 | 600 - 699 | 400 - 499
900 - 999 | 700 - 799 | 500 - 599 | < 399

CONCENTRATION OF FRACKING



> 400 WELLS | 0 - 149 WELLS | NO SHALE
150 - 399 WELLS | NO WELLS



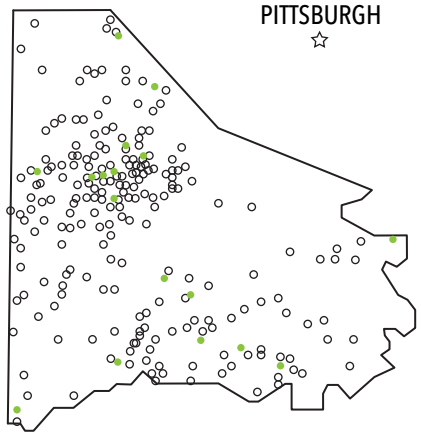
WASHINGTON COUNTY

Washington County has the highest number of wells of any county in Pennsylvania, and it's also a large farming community. Interestingly, the county is also a suburb of the city of Pittsburgh - one of the few large cities that would not disappear with rising sea levels.

In "Collaborating with Catastrophe"s vision of 2030, the farming community of Washington County is supporting the population of Pittsburgh, supplying much of the city's food.

The county had 2,023 farms as of 2010, covering a total of 211,053 acres - averaging out to 104 acres per farm.[19]

DENSITY OF WELLS



○ = 1 DRILL PAD [MULTIPLE WELLS]

• = REPORTED VIOLATION

COUNTY AREA = 857 SQ MILES

TOTAL COUNTY WELLS = 1,146

1.33 WELLS PER SQ MILE

19. "Welcome to an Engaged Community." Washington County, PA. http://www.co.washington.pa.us/index.aspx?NID=173.

CONCENTRATION OF FARMS MAP
"Agriculture in Pennsylvania." Wikiwand. http://www.wikiwand.com/en/Agriculture_in_Pennsylvania.

CONCENTRATION OF FRACKING MAP
"The Economic Effects of Hydrofracturing on Local Economies." Empire Center for Public Policy. http://www.empirecenter.org/publications/the-economic-effects-of-hydrofracturing-on-local-economies/.

WASHINGTON COUNTY WELLS MAP
"Washington | Shale Play: Natural Gas Fracking in Pennsylvania." StateImpact Pennsylvania. http://stateimpact.npr.org/pennsylvania/drilling/counties/washington-county/.

FIGURE 26
"Pennsylvania Counties with Active Wells." StateImpact Pennsylvania. http://stateimpact.npr.org/pennsylvania/drilling/counties/.

10^3 - THE FARM

THE PROGRAM . THE SITE

"Collaborating with Catastrophe"'s end product will be a farm in Washington County, PA, in the year 2030. Hydrofracking is still occurring, and so the farm is sharing it's land - about 6 acres total per well between the pad, infrastructure, and fluid pits.

The average farm size in Washington County is 104 acres, with a majority of farms between 50 and 180 acres (Figure 27). This thesis aims to design a farm of 100 acres, typical of the area. Most land use in the county is split between cropland and pastures for livestock (Figure 28), and this farm will endeavor to do both, providing a diversity of food types for the nearby city of Pittsburgh.

The major contentions that the farm will be dealing with in the year 2030 are the overlap of hydrofracking demands on both space and resources, the now arid climate which demands new methods of growing, and water scarcity, efficiency of use, and remediation which both major programs depend on.

This section researches a range of potential approaches to these problems, from vernacular methods of farming in arid climates - including irrigation and rainfall collection systems and dry farming crop selections - to newer technologies including hydroponics and algae water remediation and fertilizer techniques. The systems needed in order to farm and frack simultaneously in the new environment might be massive and oppressive, but counter-intuitively to the norm, in "Collaborating with Catastrophe" the more absurd the demands of such systems are, the better the thesis fulfills it's aim of becoming a jeremiad. Although the aim is to be absurd, the aim is also to be believable, and so all design is supported with facts and science rooted in biology, ecology, and geology.

FIGURE 27
"Washington County - Pennsylvania". Census of Agriculture, Volume 1, Geographic Area Series. 2012.

FIGURE 28
"Washington County - Pennsylvania". Census of Agriculture, Volume 1, Geographic Area Series. 2012.

FARM SIZE, WASHINGTON COUNTY

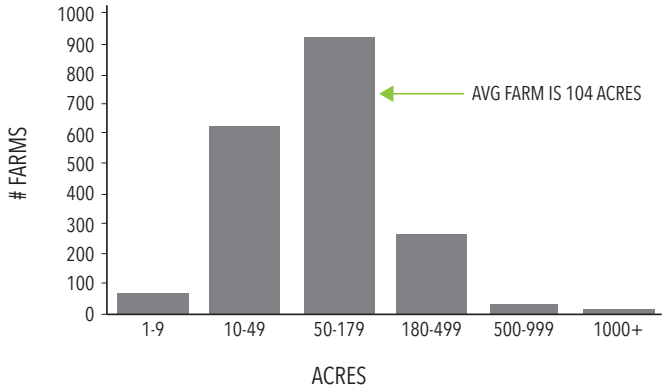


FIGURE 27

LAND USE, WASHINGTON COUNTY

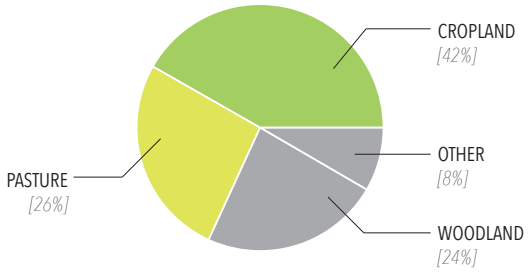
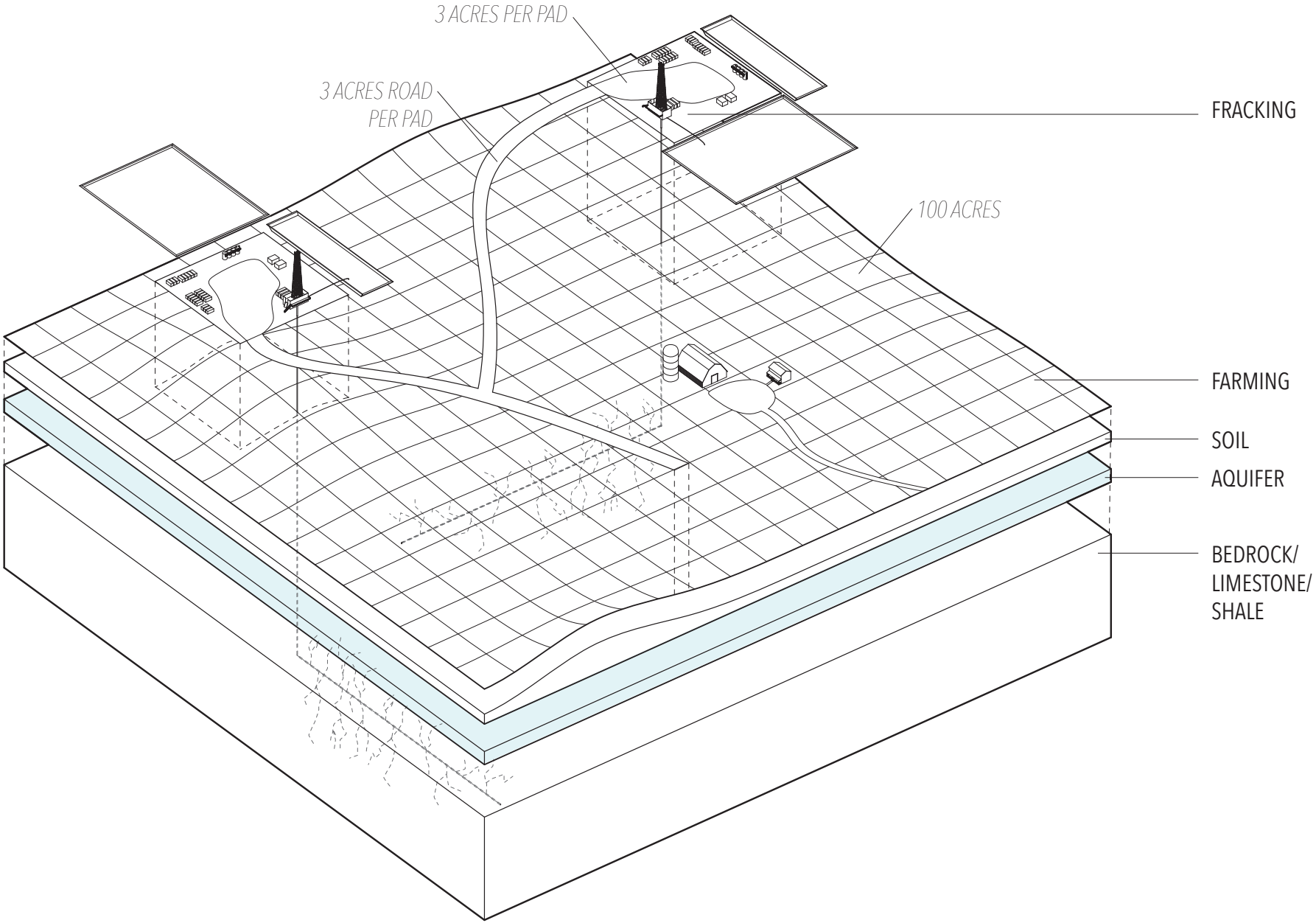


FIGURE 28

FARM/FRACK OVERLAP - A FARM



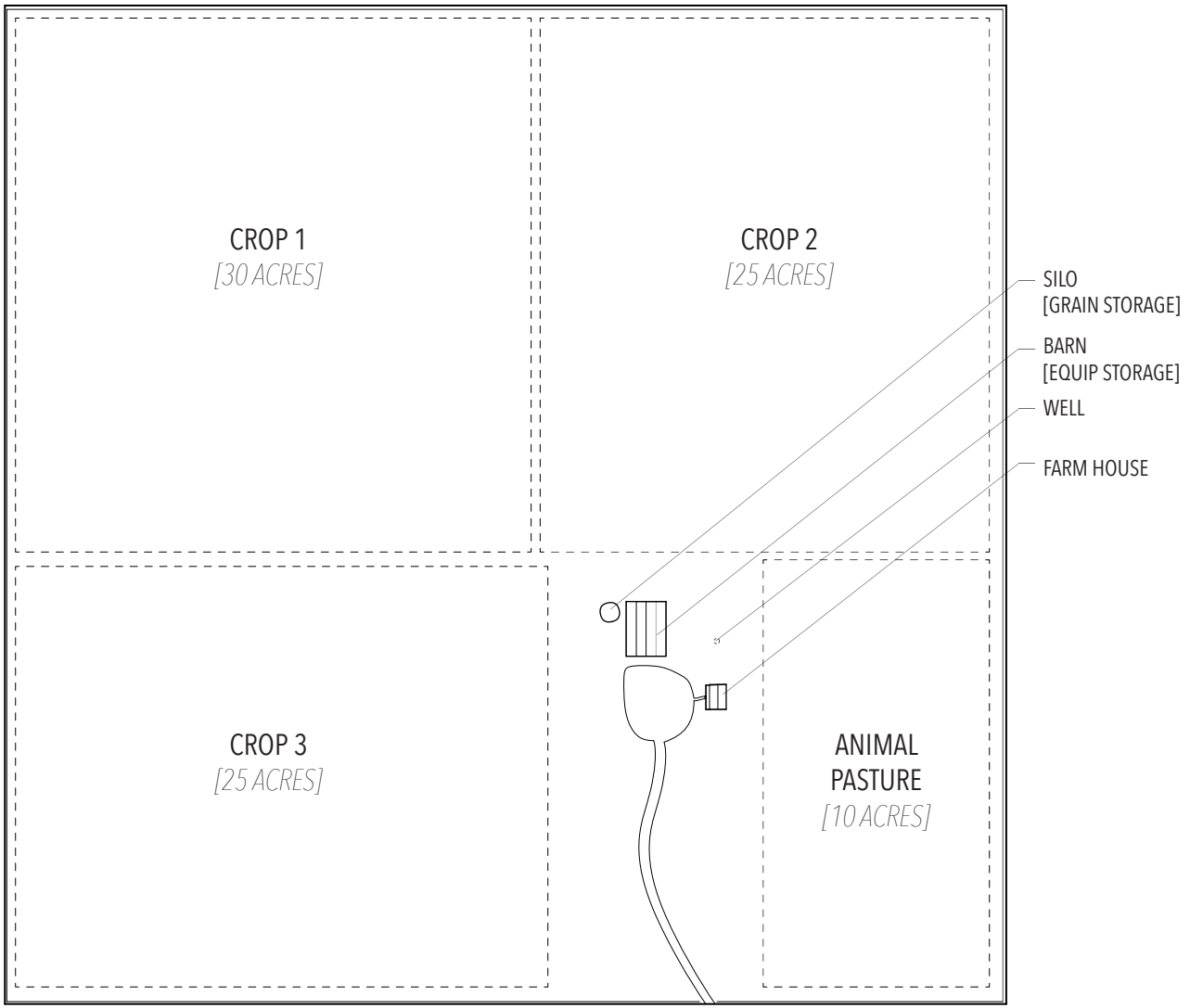
CONVENTIONAL FARMS OF 2015 [SANS FRACKING]

The average farm of Washington Co. is 104 acres. This thesis seeks to design a farm of 100 acres - very close to the average, and for that reason, is using a contemporary 100 acre farm as a case study.

Farms of that size typically grow between 1 and 3 varieties of crops, breaking up the land into sections, and growing one type per area. Additional land might be used to graze animals or grow a vegetable garden for the land owners, who usually reside on the property. All equipment, harvested crops, and animals are stored on site in either the barn or silos.

The plan of farms are very organized, with little to no overlap of function.

In section, there is little movement, the major limiting factor of how much a farm is able to produce being the amount of space at ground level the farm covers. This is due to reliance on soil in typical farming methods.



PLAN

SECTION






WASHINGTON CO. FARMS

ALL PHOTOS
"Washington County, PA, For Sale." Land And Farm. Accessed December 13, 2015. http://www.landandfarm.com/.

WATER SCARCITY + IMPACT

Arguably the largest challenge that farmers are going to face as a result of climate change is the struggle to have enough fresh water to feed their crops and livestock. Farming demands a massive amount of water, making up over 70% of the demand worldwide (Figure 29). Many economists and water geography experts are calling water the petroleum of the next century, and predicting that it will be the cause of the next big global conflicts and wars.[20]

With demands in Washington County split between fracking and farming in 2030, it becomes even more crucial that farmers use water conservative farming techniques - which will impact the design of farms, the amount of crops able to be produced, the number of people able to be fed, the types of crops able to be grown, and even the culinary culture of the region. This means alternative techniques such as dry farming might become the new norm.

Additionally, methods of water remediation and reuse become increasingly important. If contaminated water from hydrofracking or from daily human use can be cleaned and recycled back into use, then farming in these regions remains a viable option. Such processes would need integration into typical farming system structures, and would as a result alter the process into something new. It is the intersection of the overlapping of these processes necessitated by environmental conditions - dry farming, fracking, water conservation, and water reuse - and the farm design which those overlaps demand that "Collaborating with Catastrophe" seeks to explore.

WORLDWIDE FRESH WATER USE

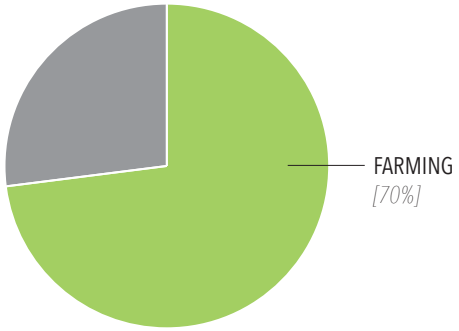
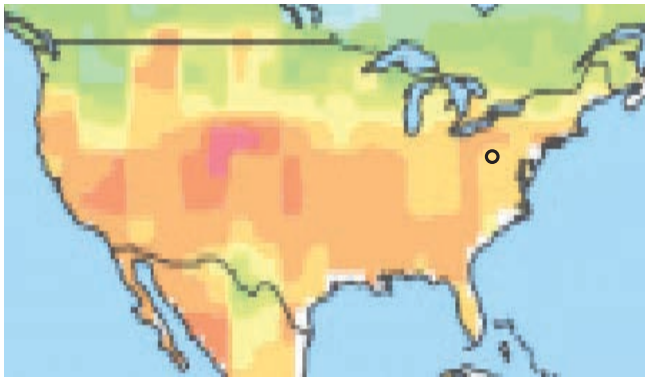


FIGURE 29

20. Judge, Clark S. "The Coming Water Ware." US News and World Report. February 13, 2013. http://www.usnews.com/opinion/blogs/clark-judge/2013/02/19/the-next-big-wars-will-be-fought-over-water.

21. Gliessman, Stephen R. Agroecology: The Ecology of Sustainable Food Systems. 2nd ed. Boca Raton: CRC Press, 2007. 72.

PRECIPITATION 2010



PRECIPITATION 2035

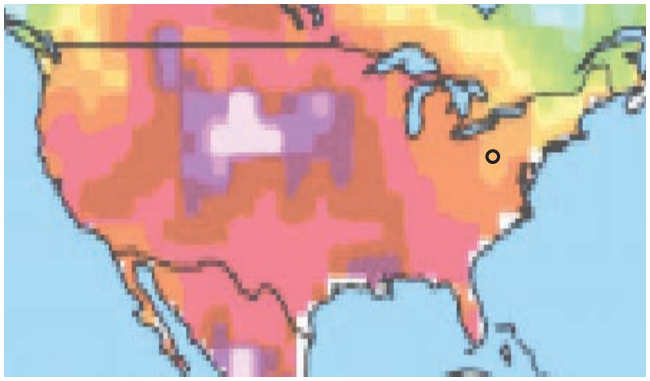


FIGURE 30

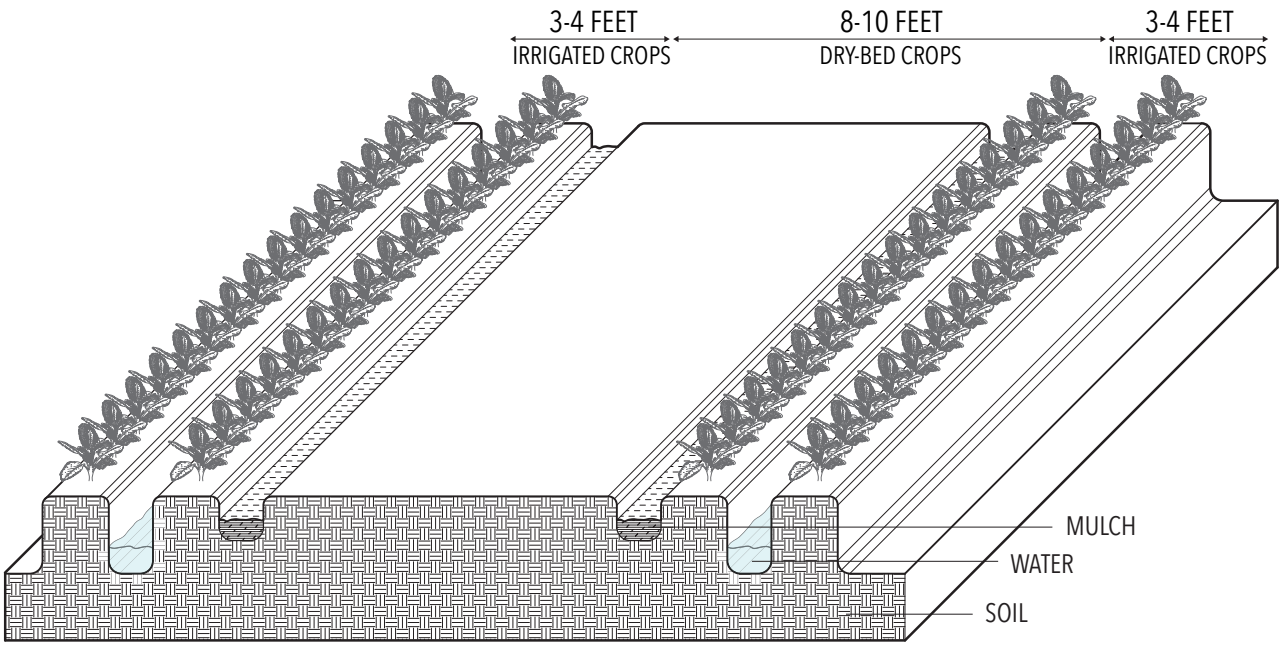
FIGURE 29
"Water Use in Agriculture." OECD. http://www.oecd.org/agriculture/wateruseinagriculture.htm.

FIGURE 30
"Future Climate Change." EPA..http://www3.epa.gov/climatechange/science/future.html#increasinggreenhouse gas.

FIGURE 31
"Guar Growing Cycle." Farming - Guar Global Ltd. http://www.guarglobal.com.

FIGURE 32
"Texas Water Report:Going Deeper for the Solution." Texas Water Report. January 14, 2014. http://comptroller.texas.gov/specialrpt/water/gamechangers/dryland.php.

FIGURE 33
"For Rio Grande Valley Farmers, Dreams Drying up." San Antonio Express-News. http://www.expressnews.com/news/item/For-Valley-farmers-dreams-drying-up-24067.php.



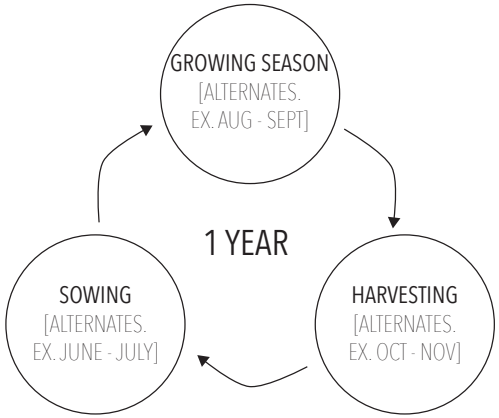


FIGURE 31

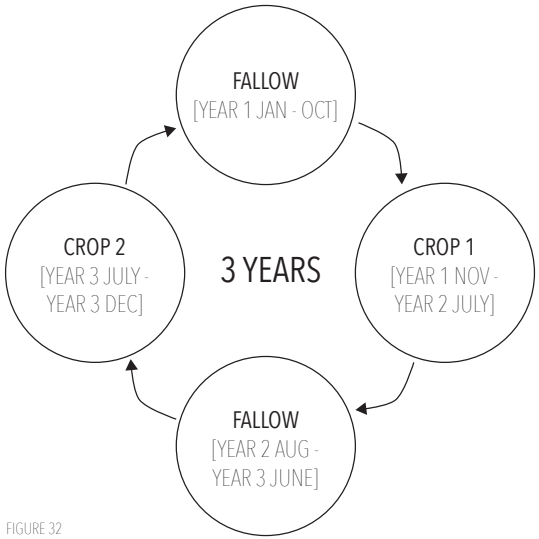


FIGURE 32

DRY FARMING

Used for centuries by indigenous people in arid climates, dry farming is a solution when either the area does not receive enough rainfall, or then the growing season does not coincide with the wet season.[20] It is an alternative to irrigation, and has the potential to be useful in this thesis because it uses relatively little water and is a low energy solution - capturing water and allowing it to sink quickly into the plant roots rather than being lost to eventual evaporation.

Dry farming has two key aspects - the first being a cultivation system with a section and material usage that promotes rainwater storage and penetration. And the second in the use of frequent summer fallows (Figure 31), as opposed to the typical growing season cycle where summers are key (Figure 32).

This technique has been used historically in the Negev Desert in Israel, Australia, and parts of western Canada and the continental U.S.

FIGURE 33

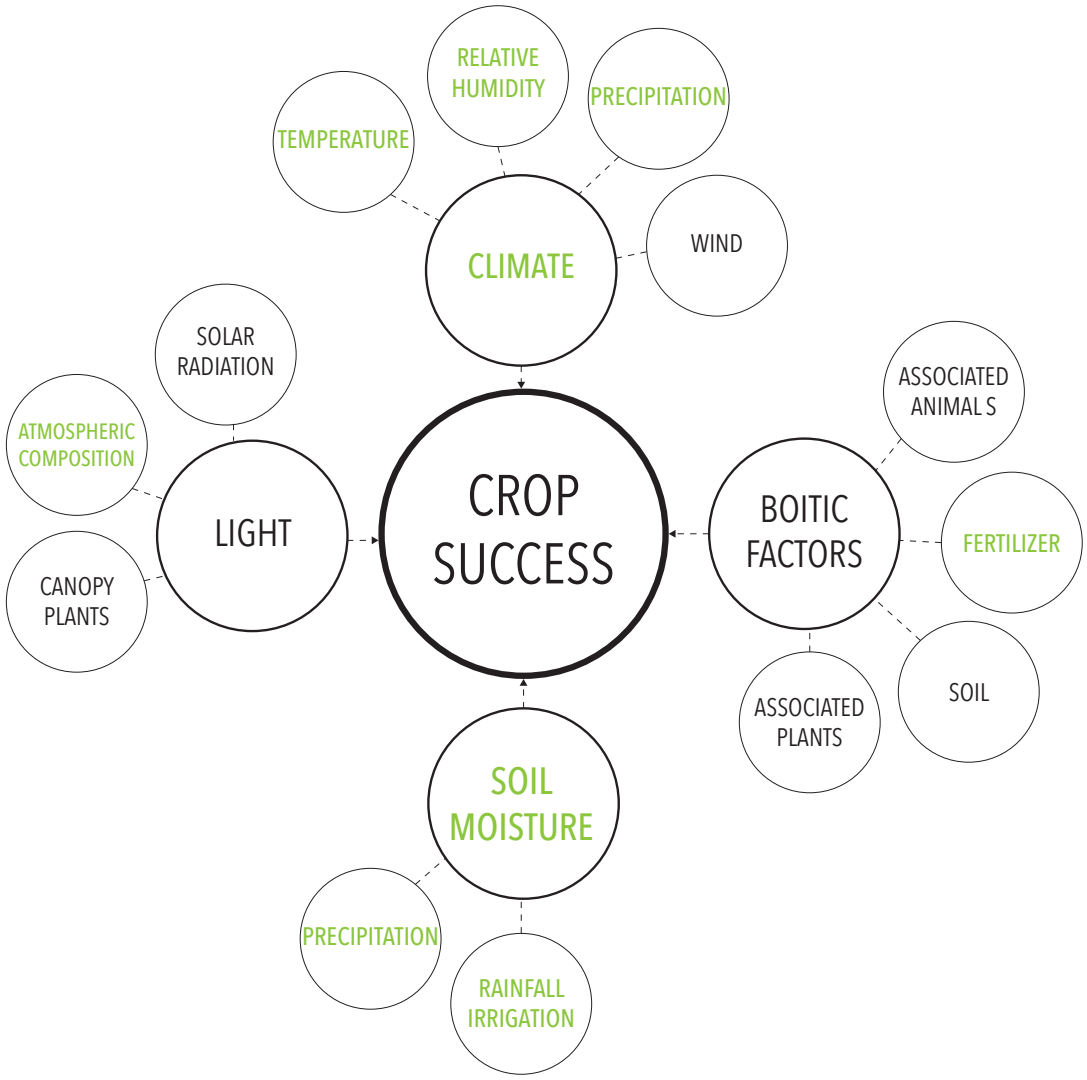
CROP SELECTION

When selecting crops to be grown, the environment is the key consideration, consisting of complex relationships which dictate what will grow successfully (Figure 34). Light, precipitation, temperature, and soil type are all abiotic factors which must be considered, as well as the biotic factors such as the relationship to other plants and animals in the ecosystem, the nutrient fertility of the soil, and the human factor.

In choosing crops for the farm of "Collaborating with Catastrophe", the two key factors became water needs and growing cycles, so they could be managed in a dry farm system.

To the far right is a table of some of the crops which fit the criteria, and can thus be grown successfully in the arid 2030 Pennsylvania.

FIGURE 34
Gliessman, Stephen R. Agroecology: The Ecology of Sustainable Food Systems. 2nd ed. Boca Raton: CRC Press, 2007. 144-145.



COLOR KEY:
DIRETLY AFFTECTED BY CLIMATE CHANGE
NOT DIRETLY AFFTECTED BY CLIMATE CHANGE

FIGURE 34

crop . WHEAT
production per acre .
35 BUSHELS = 1,470 LOAVES OF BREAD
planting . WINTER OR SPRING.
harvest .10 MONTHS AFTER PLANTING

crop . CORN
production per acre .
183 BUSHELS
planting . APRIL - JUNE
harvest .OCTOBER - NOVEMBER

crop . POTATOES
production per acre .
25,000 lbs
planting . MARCH - APRIL
harvest .JULY - AUGUST
note . BEST IN SANDY SOIL

crop . BARLEY
production per acre .
48 BUSHELS
planting . WINTER OR SPRING.
harvest .10 MONTHS AFTER PLANTING

crop . CASSAVA
production per acre . 30 MT
planting . ANYTIME WITH PROPER IRRIGATION
harvest .12 MONTHS AFTER PLANTING
note .150 CM WATER TOTAL

crop . MIXTA SQUASH
production per acre .
1,000 - 7,000
planting . APRIL - MAY
harvest . 2 MONTHS AFTER PLANTING

crop . SORGHUM
production per acre .
80 BUSHELS
planting . MAY - JUNE
harvest .OCTOBER - NOVEMBER

crop . PIGREON PEAS
production per acre .
1-2 TONS DRY PEAS
planting . APRIL - MAY
harvest .6-7 MONTHS AFTER PLANTING

crop . COMMON BEAN
production per acre .
166 KG
planting . MAY - JUNE
harvest .4-6 WEEKS AFTE PLANTING

crop . OKRA
production per acre .
4-6 TONS
planting . MAY
harvest . 2 MONTHS AFTER PLANTING

ALGAE INTERVENTION

In the year 2030, algae is the saving grace of farming due to its ability to remediate waste water, clean air, and act as a food, fuel or fertilizer source in its afterlife. These capacities make it *the* crop of the post-apocalyptic farming community, helping to support other crops through providing clearn fresh water and nutrients.

Algae "eats" phosphate and nitrogen compounds, converting them to lipids which are then able to be converted into biofuel. Those compounds exist in wastewater, and in the process of metabolizing them, the algae simultaneously cleans the water - a key fact in a world plagued by drought, seeking to conserve water anyway possible. It's also a much more efficient means of producing biofuel in terms of space - producing as much as 78 times as much biofuel per hectare as alternative plants (Figure 36). This gives future farms a cleaner source of energy, as well as a low energy input means of remediating the massive amounts of wastewater that the agricultural process produces.

Afterwards, the algae can be used as a nitrogen based fertilizer on the farm, the demand for which is very high, making up the highest percentage of energy demands in modern day industrial farming processes (Figure 35). The other alternative is to use the algae as a crop itself, as a source high in proteins, lipids, and micronutrients.

Algae is poised to become the cash crop of the future, serving a multitude of purposes. As a result, it will change standard farming practices and organizations, and have long-range impacts culturally - from how the cars of the future are fueled, to what food is put on the table at dinner. This thesis imagines the farm where algae is already an integrated part of day-to-day functions.

FIGURE 35
Gliessman, Stephen R. Agroecology: The Ecology of Sustainable Food Systems. 2nd ed. Boca Raton: CRC Press, 2007.

FIGURE 36
Deutsch, Claudia. "A Single Source for Clean Water and Fuel." New Scientist. April 6, 2011. https://www.newscientist.com/article/mg21028075-300-a-single-source-for-clean-water-and-fuel/.

ENERGY USE IN FARMING

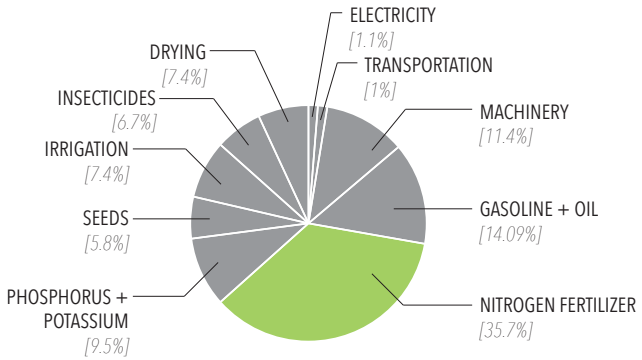


FIGURE 35

BIOFUEL PRODUCERS PER ACRE

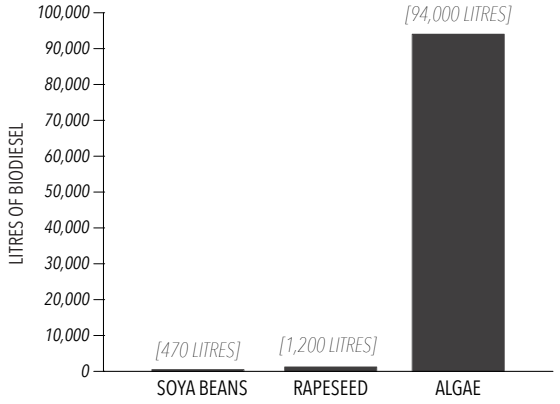
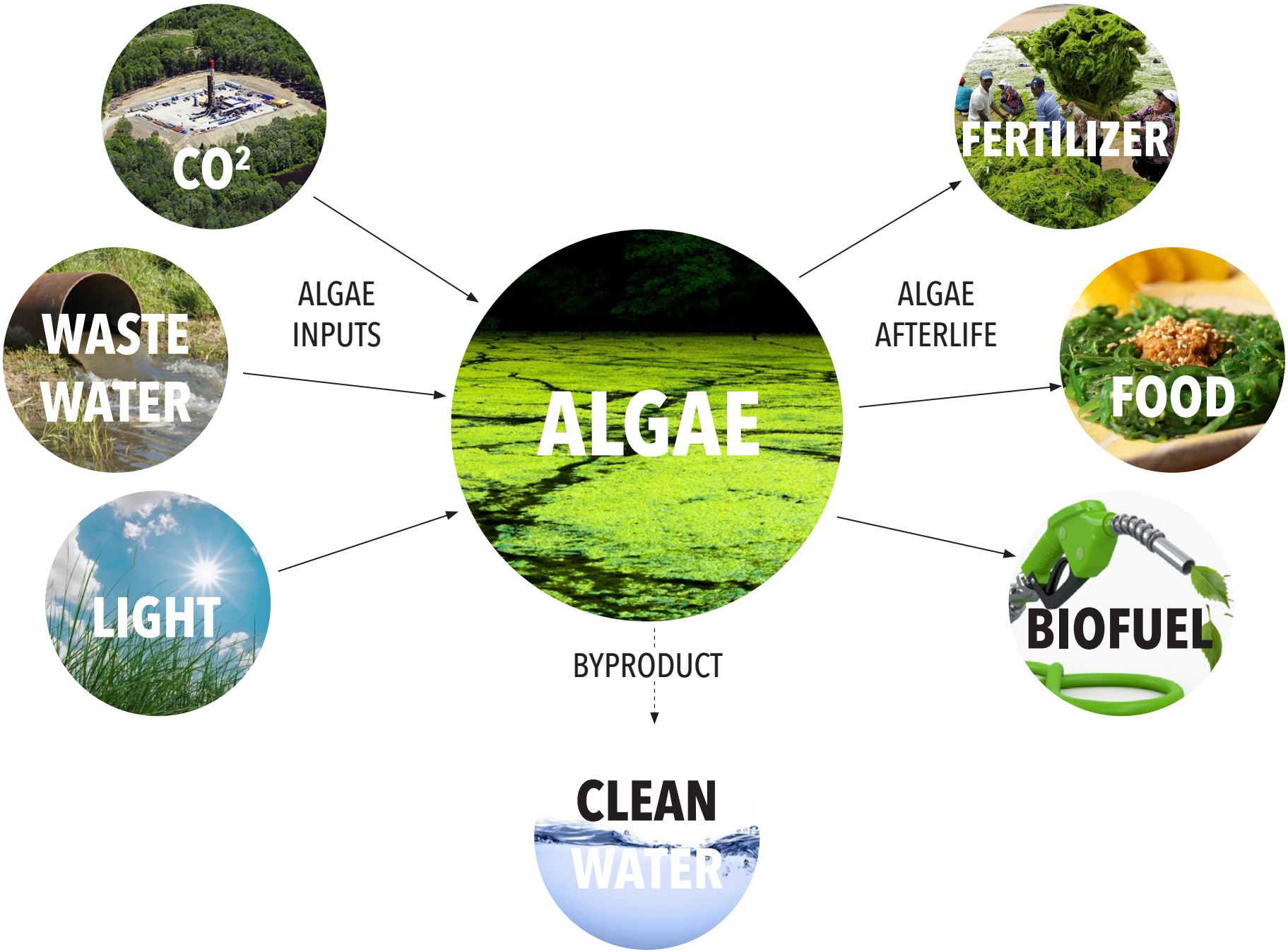


FIGURE 36


CO^2
WASTE WATER
LIGHT
ALGAE INPUTS
ALGAE
ALGAE AFTERLIFE
FERTILIZER
FOOD
BIOFUEL
BYPRODUCT
CLEAN WATER

10^{-1} - THE SOIL

The fluid pits which hydrofrackers keep on site are filled with chemical contaminated water and prone to leaks (Figure 37) - resulting in contaminated soil for the neighboring farms.

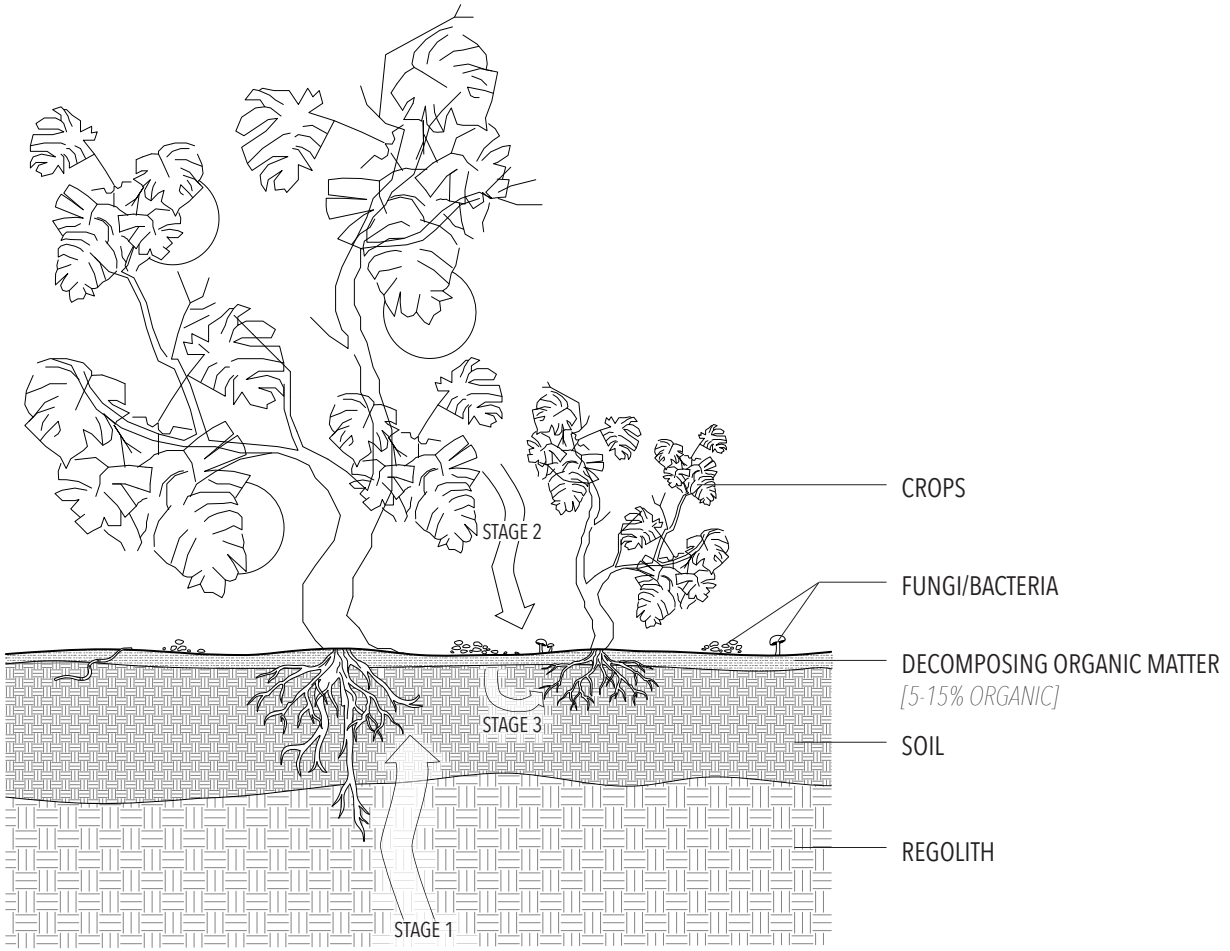
To understand the impacts of this, it's prudent to first understand the layering structure of soil and how plants recieve their nutrients, in order to then intervene in productive ways.

FIGURE 37

FIGURE 37
"Plan for Fracking's Waste Pits Could Save Millions of Birds." Inside Climate News. June 15, 2015. http://insideclimatenews.org/news/09062015/fracking-gas-drilling-waste-pits-could-save-millions-birds-hydraulic-fracturing-audobon-society.

FIGURE 38
BASED ON: Gliessman, Stephen R. Agroecology: The Ecology of Sustainable Food Systems. 2nd ed. Boca Raton: CRC Press, 2007. 89.

TYPICAL SOIL STRUCTURE
+ NUTRIENT MOVEMENT



STAGE 1: MINERALS FROM THE REGOLITH ARE REACHED BY THOSE PLANTS WITH THE DEEPEST ROOTS AND ABSORBED INTO THE GROWTH OF THE PLANT

STAGE 2: AS PARTS OF THE PLANTS DIE AND FALL TO THE GROUND BELOW AND BEGIN TO DECOMPOSE THE MINERALS CONTAINED WITHIN ARE RELEASED

STAGE 3: THE MINERALS BECOME PART OF THE TOP SOIL, ALLOWING PLANTS WITH SHALLOWERS ROOTS ACCESS TO THE NUTRIENTS

FIGURE 38

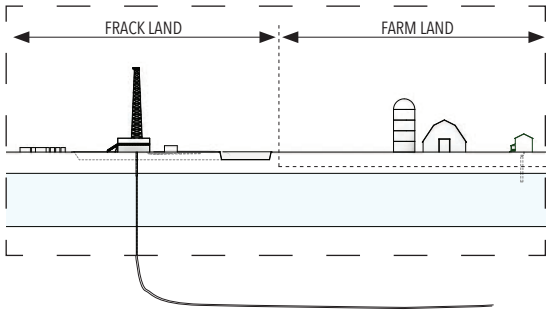
Due to the proximity of hydrofracking and farming, chemicals, natural gas, and methane have the capacity to pollute both water and soil of neighboring farms. Remediation techniques are expensive and not entirely effective, rendering some land unproductive for growing crops.

However, in any environment where something is dying, something else is also thriving. In this case, on the microbial level, certain bacteria and algae have been found to metabolize methane, heavy metals, and natural gas are able to survive, which means on the micro-scale these environments could be hosts of new ecologies which could act as remediating forces. Most often these life forms are found at the bottom of oceans, surviving on the edges of gas seeps on the sea floor, in environments of extreme heat, pressure, and toxicity (Figure 39). Currently, oil and mining companies are attempting to domesticate these life forms for resource extraction and clean up.[22]

"Collaborating with Catastrophe" believes that such ecologies hold the answer to surviving in human contaminated landscapes. However, in order for such life forms to be supported, their other needs must be met - such as the presence of sulfates, or the cleaning of the hydrogen sulfide that they produce, which is harmful to humans.[23] This means new structures would need to be put in place to allow for the domestication of these bacteria.

This thesis projects that by the year 2030, those needs might have been solved for, and so extremophiles could realistically be a viable part of a farm's ecosystem near fracking pads.

EXTREMOPHILES AS HEALERS



22. Korody, Nicholas. "Between Sampling and Dowsing: Field Notes from GRNASFCK." Archinect. April 30, 2015. http://archinect.com/features/article/125765734/between-sampling-and-dowsing-field-notes-from-grnasfck.

23. Kusek, Kristen M. "Microbes That 'Eat' Natural Gas." Oceanus Magazine. October 4, 2007. http://www.whoi.edu/oceanus/feature/microbes-that-eat-natural-gas.

FIGURE 39

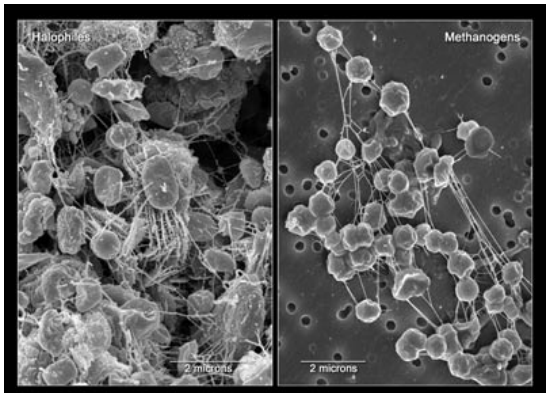


FIGURE 40

FIGURE 39
"What Is an Extremophile?" NOAA, National Ocean Service. http://oceanservice.noaa.gov/facts/extremophile.html.

FIGURE 40
Silverman, Jacob. "How Extremophiles Work." HowStuffWorks. http://science.howstuffworks.com/life/cellular-microscopic/extremophile.htm.

HYDROPONIC OPTION

Hydroponics is a method of crop production that removes soil from the process, as well as all of the contaminates, pests, and pollutants that come with it. This means that in an environment where the quality of soil cannot be assured, like near a hydrofracking well, hydroponics might be the safest solution.

Although the crops produced with the system can be water intensive, the controlled process allows for the capture of water and limits the amount lost to evaporation, as opposed to exterior soil based methods of farming.

Additionally, hydroponics can be stacked as opposed to more conventional farming methods, meaning more output per sq ft (Figure 42).

FIGURE 41
"The Future of Food Supply in the City Revisited." Urban 360. July 26, 2011. http://urban360.me/2011/07/26/vertical-farming-at-the-city/.

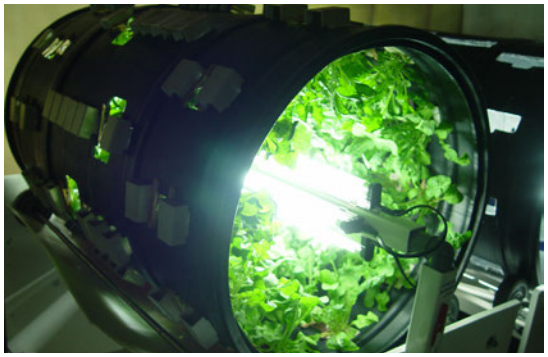
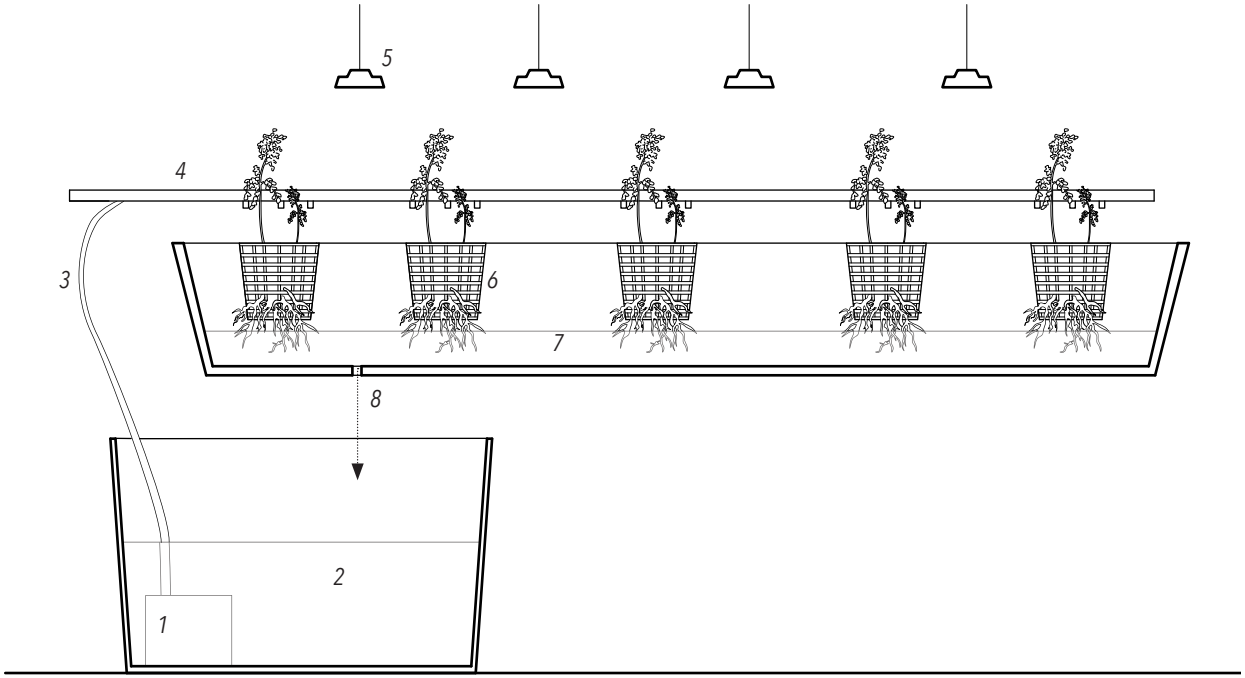


FIGURE 41

TYPICAL HYDROPONIC SYSTEM COMPONENTS



1 WATER PUMP
2 RESEVOIR
3 WATER HOSE
4 WATER DISTRIBUTION PIPE
5 ARTIFICIAL LIGHTING
6 ROOT BASKETS
7 OVERFLOW WATER
8 OVERFLOW DRAIN

HYDROPONIC CROPS

Not all crops grow well hydroponically. The ideal produce requires minimal space, making large grain crops unfeasible.

However, the benefits of hydroponic farming are numerous. The environment can be 100% controlled to produce the best growing conditions, including light control, removal of pests, and measured water allotments. Additionally, due to the lack of soil which therefore does not require time between growing seasons to replenish nutrients, and the lack of reliance on climate, growing cycles can be continuous throughout the year, resulting in a much higher yield per sq ft.

crop . LETTUCE
production per acre .
3 MILLION HEADS PER YEAR
growing time . 48 DAYS
annual growing cycles . 7

crop . CARROTS
production per acre .
163,350 LBS PER YEAR
growing time . 66 DAYS
annual growing cycles . 5

crop . STRAWBERRIES
production per acre .
120,000 LBS PER YEAR
growing time . 84 DAYS
annual growing cycles . 4

crop . BASIL
production per acre .
217,800 LBS PER YEAR
growing time . 36 DAYS
annual growing cycles . 10

crop . TOMATOES
production per acre .
1,742,000 LBS PER YEAR
growing time . 96 DAYS
annual growing cycles . 3

crop . CUCUMBERS
production per acre .
320,000 CUCUMBERS PER YEAR
growing time . 150 DAYS
annual growing cycles . 2

FIGURE 42

FIGURE 42
"Community." Homegrown Hydroponics RSS2. http://www.hydroponics.com/blog/.

LEARNING FROM [...]

ARCHITECTURE AS MEDIUM
CONTAMINATED LANDSCAPES

"If architecture wants to engage the environmental problem in any meaningful and consequential way, it cannot content itself with joining the mainstream drive towards technological innovation and triple-bottom-line compromises; rather it will need to reframe its own disciplinary identity and role relative to society and nature from an ecological perspective.

Jascke, Karin. "Acting Up." In Agency: Working With Uncertain Architectures, edited by Florian Kossak, Doina Petrescu, Tatjana Schneider, Renata Tyszczuk, and Stephen Walker. Routledge, 2009.

ARCHITECTURE AS MEDIUM

Many believe that a key characteristic of architecture is that it is built; however, this thesis operates under the idea that architecture can serve a purpose as an unbuilt project, designing the as of yet unbuildable or proposing new ideas. The projects in this section are key to architectural discourse, yet are all unbuilt. Instead, they acted symbolically or as instigators in the profession - inspiring the next generation of architects. Here, architecture is another method of communicating ideas, as opposed to a written narrative or a painting. It is another medium.

"Collaborating with Catastrophe" is by necessity set in an imagined future, and as such acts in tandem with these projects.

RUSSIAN CONSTRUCTIVISM

FIGURE 43

architect . YAKOV CHERNIKHOV
project . FANTASTIC COMPOSITION
date . 1925-1932
narrative . SITE LESS, PROGRAM LESS, UTOPIA OF AESTHETICS
desired effect . MEANT TO INSPIRE RATHER THAN PROPOSE. GIVES PRECEDENCE TO IMAGINATION

RUSSIAN DECONSTRUCTIVISM

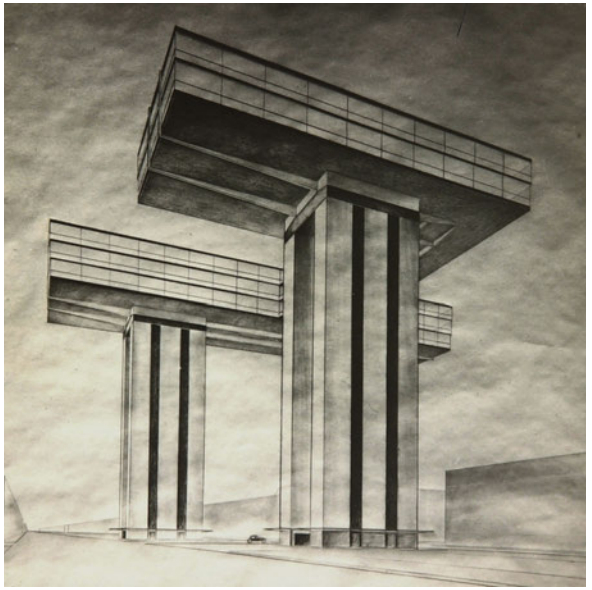


FIGURE 44

architect . EL LISSITZKY
project . SKY HOOKS
date . 1923-1925
narrative . IN A GROWING MOSCOW, THESE SKYHOOKS WOULD BE PLACED AT INTERSECTIONS, USED TO TRANSPORT PEOPLE AND GOODS TO THEIR DESTINATION.
desired effect . EXPLORES THE CITY CHANGING FROM ONE OF HORIZONTALITY TO VERTICALITY

FIGURE 43
"Yakov Chernikhov." VisualizeUs. http://vi.sualize.us/yakov_chernikhov_constructivism_architectural_fantasy_picture_3X9g.html.

FIGURE 44
Golenda, Gabriella. "Cloud-Irons: 6 Buildings That Emphasize the Elevated Horizontal Plane." Architizer. February 10, 2015. http://architizer.com/blog/horizontal-skyscrapers/.

FIGURE 45
"Living in His World: Antonio Sant'Elia 1888-1916." Core77. http://www.core77.com/posts/18159/Living-in-his-world-Antonio-SantElia-1888-1916.

FIGURE 46
"Walking City." Archigram Archival Project. 2010. http://archigram.westminster.ac.uk/project.php?id=60.

FIGURE 47
Glancey, Jonathan. "Anti-matter. Superstudio: Life Without Objects." The Guardian. March 31, 2003. http://www.theguardian.com/artanddesign/2003/mar/31/architecture.artsfeatures.

ITALIAN FUTURIST

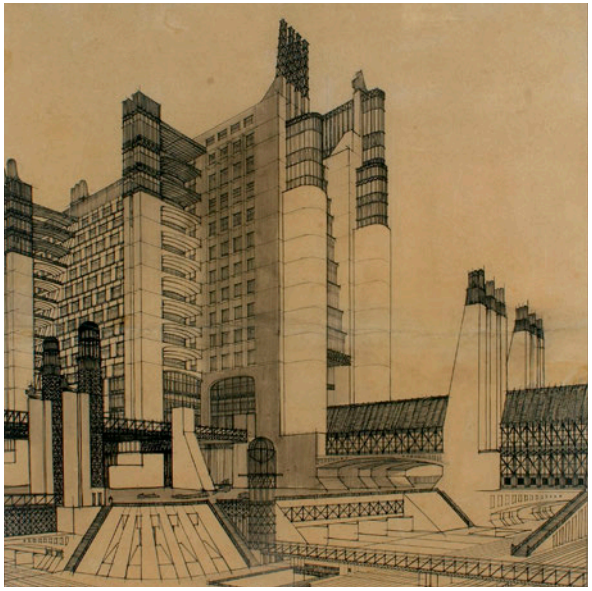


FIGURE 45

architect . ANTONIA SANT'ELIA
project . LA CITTA FUTURISTA
date . 1913
narrative . THE INDUSTRIAL AND HIGHLY MECHANIZED CITY OF THE FUTURE. MULTI-LEVEL, INTERCONNECTED URBANITY.
desired effect . SYMBOLIZED A NEW AGE. CREATES EXCITEMENT FOR TECHNOLOGY AND MODERNITY

1960'S NEO-FUTURISM 1

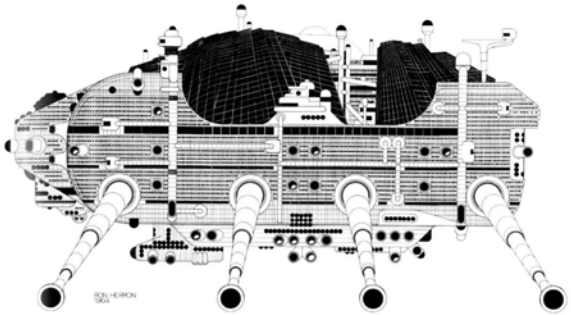


FIGURE 46

architect . ARCHIGRAM
project . WALKING CITY
date . 1964
narrative . INTELLIGENT BUILDING-ROBOTS ACT AS SELF CONTAINED LIVING PODS WHICH CAN ROAM CITIES, CHOOSING TO PLUG-IN TO EXCHANGE OCCUPANTS OR REPLENISH RESOURCES.
desired effect . PERCEIVED AS A FUTURE RUINED WORLD IN THE AFTERMATH OF A NUCLEAR WAR.

1960'S NEO-FUTURISM 2

FIGURE 47

architect . SUPERSTUDIO
project . THE CONTINUOUS MONUMENT
date . 1969
narrative . A MEGA STRUCTURE TO WRAP THE EARTH AND RESTORE COSMIC ORDER - A UNIFYING UTOPIAN ACT.
desired effect . SEEKS TO REDISCOVER THE POTENTIAL OF ARCHITECTURE

CONTAMINATED LANDSCAPES

In the process of attempting to estimate what the continental United States will look like in the year 2030 AD. if all of the scientific predictions based on global warming have come to pass and a worse case scenario is assumed for what hydrofracking has done to the agrarian countryside, "Collaborating with Catastrophe" examines cases of human caused pollution based disasters to try to distill some possible outcomes.

The Contaminated Landscape case studies are chosen to provide a variety of pollution types, dates, and geographic locations. They are then evaluated based on immediate effects, political response, remediation techniques, and long-term effects. Three of the seven examples chosen - Love Canal, Three Mile Island, and Times Beach - are located in the United States, and provide examples of both how the American government and the public respond to contamination crises, similar to the type "Collaborating with Catastrophe" seeks to emulate. All three involve an evacuation organized by the local government, followed by a clean up process. Only in the case of Three Mile Island were all residents allowed to return to their communities, as the radiation was largely contained, and there were no proven long-term effects on the public.[24] In all three cases, there was a large amount of public outcry which lead to legal reform of commercial practices. Times Beach is the only site of the three which changed program after the event, becoming a state park years after.[25]

The contamination example with the most complex after-life is Chernobyl, which resulted in a 30 km evacuation and a permanent exclusion zone. The land was then reverted into a wetland and, due to the lack of human interference, became an accidental wildlife reserve.[26] This case study has the most developed and complex ecological results.

Chosen as the most contemporary example, Fukushima is examined to show modern day advanced techniques for dealing with contamination, occurring in Japan in 2011.The accident was triggered by a natural disaster in the form of an earthquake and tsunami, and the clean up is on-going, but most of the evacuated populations have been allowed to return to their homes. The Japanese government was able to take preventative measures, quickly offering those exposed to radiation medication to treat it, and as a result there have been no deaths linked to radiation.[27]

Programmatically, the intentional spraying of Agent Orange in Vietnam by American troops has the most overlap with this thesis, as the herbicide was targeted at areas of agriculture as a way of wearing down the Vietnamese by poisoning their food source.[28] The overlap of hydrofracking with farming makes this the best case study for examining how food production is affected by contamination, and how to mediate that contamination.

The final case study is the industrial pesticide leak in Bhopal, India, and is the incident with the highest death toll. It's major relevance here is in the water and soil decontamination efforts that followed.[29]

Moving forward, "Collaborating with Catastrophe" studies the cases of Chernobyl and Agent Orange, Vietnam further.

24. "Three Mile Island." Wikipedia. Accessed November 8, 2015. https://en.wikipedia.org/wiki/Three_Mile_Island_accident.

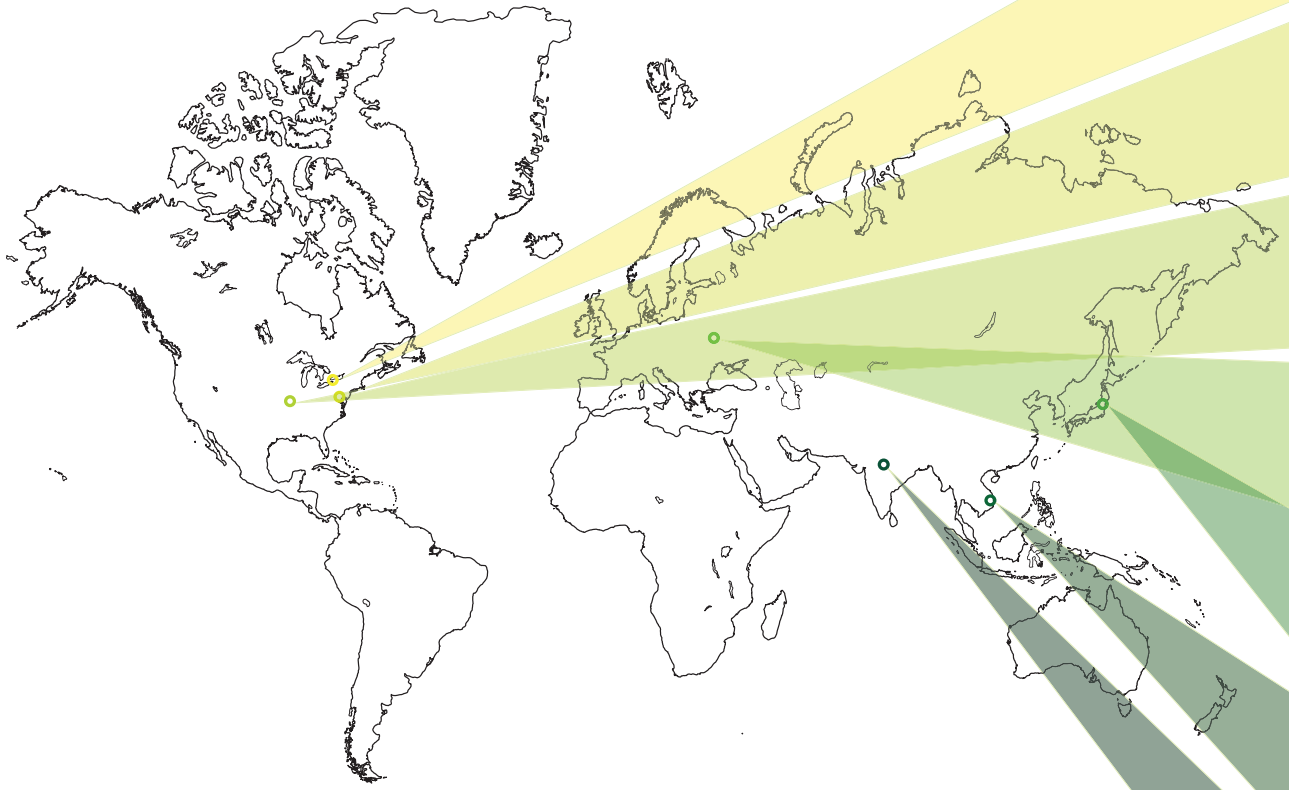
25. "Times Beach, Missouri." Abandoned Places. http://ptc2506.com/featured_sites/abandoned_places/timesbeach.html.

26. "Timeline of Events | The Chernobyl Gallery." The Chernobyl Gallery. February 15, 2013. http://chernobylgallery.com/chernobyl-disaster/timeline/.

27. Andronic, Maria. "Fukushima Disaster." Suffolk University Blogs. May 14, 2014. http://blogs.cas.suffolk.edu/mmandronic/2014/05/18/fukushima-disaster/.

28. Make Agent Orange History. 2012. http://makeagentorangehistory.org/agent-orange-resources/background/environmental-impact-of-agent-orange-dioxin/.

29. "Environmental StudiesOf the Bhopal Plant Site." Union Carbide Corporation. http://www.bhopal.com/Environmental-Studies-of-Bhopal-Plant-Site.



LOVE CANAL, NY

date . 1976
pollution type. TOXIC WASTE DUMPSITE
facet of interest: - 22,000 TONS OF TOXIC CHEMICALS
- COMMUNITY DEVELOPEMENT
- MANY PUBLIC HEALTH REPERCUSSIONS
- ENTIRE TOWN EVACUATED IN 1978

THREE MILE ISLAND, PA

date . 1979
pollution type. PARTIAL NUCLEAR MELTDOWN
facet of interest: - CONFLICTING STATEMENTS ABOUT RADIOACTIVITY
- VOLUNTARY EVACUATION, 20 MILE RADIUS
- CLEAN-UP FROM 1979 - 1993, $1 BILLION
- NO PROVEN LONG-TERM EFFECTS ON PUBLIC

TIMES BEACH, MO

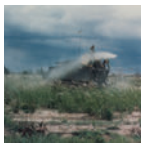
date . 1983
pollution type. DIOXIN CONTAMINATION
facet of interest . - USE OF CHEMICALS BY TOWN LATER REVEALED DEADLY
- COMPLETE EVACUATION + RELOCATION OF TOWN
- TOWN CONVERTED INTO STATE PARK

CHERNOBYL, UKRAINE (USSR c. 1986)

date . 1986
pollution type. NUCLEAR MELTDOWN
facet of interest . - LARGEST NUCLEAR DISASTER IN HISTORY
- 30 KM EXCLUSION/EVACUATION ZONE
- EFFECT OF RADIATION ON LIVING ORGANISMS
- TODAY ACTS AS AN ACCIDENTAL WILDLIFE RESERVE

FUKUSHIMA, JAPAN

date . 2011
pollution type. NUCLEAR MELTDOWN
facet of interest . - CONTEMPORARY DISASTER + CLEAN-UP
- TRIGGERED BY NATURAL WEATHER DISASTER
- EVACUALTION. NO DEATHS LINKED TO RADIATION
- RADIATION LEAKED INTO OCEAN



AGENT ORANGE, VIETNAM

date . 1961-1971
pollution type. HERBICIDE WARFARE
facet of interest . - TOXIN SPECIFICALLY TARGETED TO KILL PLANTS
- WARFARE TACTIC
- OVER 500 MILLION ACRES OF LAND COVERED, AFFECTING CROPS AND FOOD PRODUCTION

BHOPAL, MADHYA PRADESH, INDIA

date . 1984
pollution type. PESTICIDE LEAK
facet of interest . - MASSIVE DEATH TOLL
- OVERNIGHT. LET OFF CHEMICAL GAS CLOUD
- SOCIALLY DISRUPTED COMMUNITY FOR DECADES
- WATER AND SOIL DECONTAMINATION EFFORTS

CHERNOBYL, USSR
1986

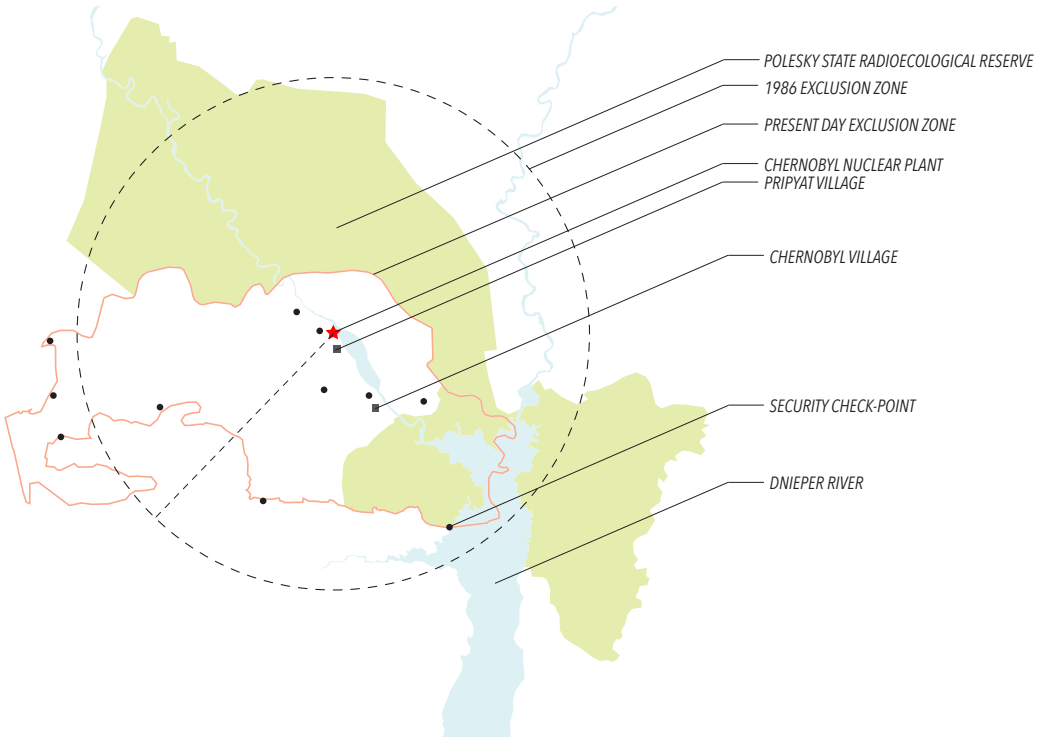



FIGURE 48

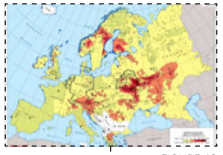


FIGURE 49

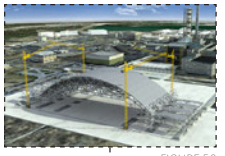


FIGURE 50

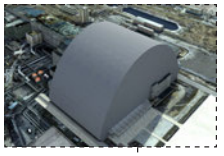
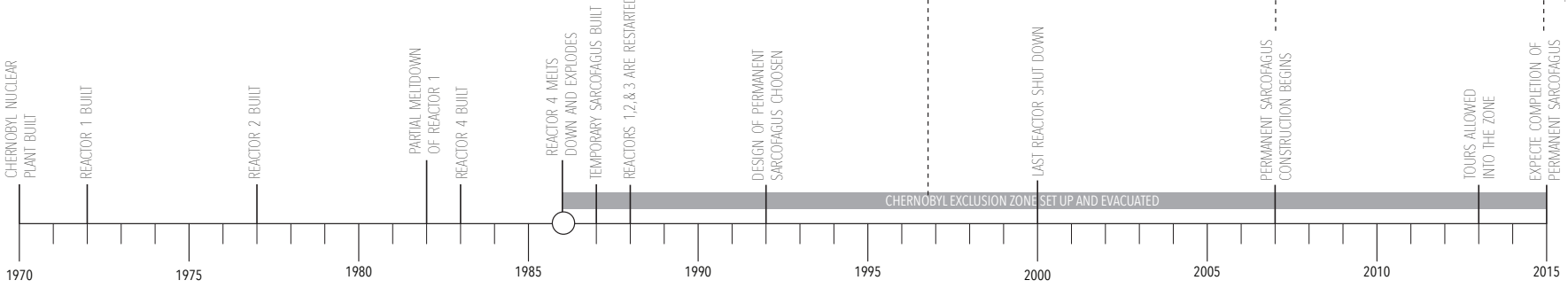


FIGURE 51



Pollution Type: Chernobyl is classified as a level 7 nuclear disaster on the International Nuclear Event Scale - the only other level 7 in history being Fukushima. During a routine systems test of Reactor 4 on April 26th, 1986, a power surge causing a malfunction in the core cooling system. Soviet Engineers continued the testing, leading to a meltdown and explosion at 1:23 AM.[30] A radioactive cloud was released into the air, containing more that 400 times the amount of radioactivity of the atomic bombing of Hiroshima. Approximately 100,000 km^2 of land was affected, the most in Belarus, the Ukraine, and Russia (Figure 28).

Short Term Effects: In the immediate aftermath 237 people suffered from acute radioactive sickness, and there were 31 deaths. A 30 km evacuation zone was set up surrounding the power plant. In the time since, another 4000 deaths due to cancer have been linked to the radiation release.[31]

Economic and Political Impact: The Chernobyl disaster can be linked to the eventual dissolution of the USSR in 1991 and in the strengthening of ties between the U.S. and the USSR due to bio-scientific collaboration.

Remediation Technique: The area around Pripyat was returned to wetland in order to avoid further radiation spread, to reduced the risk of fire which would release the radiation captured in the trees (Figure 32).[32] In an attempt to contain the radiation, a temporary sarcophagus was constructed in 1987 (Figure 27), with a permanent one to be completed in 2016 (Figure 30).

Long Term Effects: A permanent exclusion zone has been established, the boundary based on radiation levels in the area. Due to the absence of humans for the past 30 years, the zone has become an accidental wildlife reserve and haven for migratory birds. Certain types of bacteria which thrive in radiation are also now found in the zone, producing a unique ecological environment.

Take Away: In any environment where something is dying, something is also thriving. In this case, although the conditions are dangerous for humans, other forms of life are able to take hold, producing an unlikely biological case study.

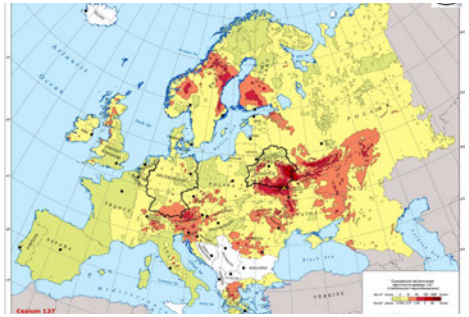


FIGURE 49

FIGURE 52

FIGURE 53

30. "Timeline of Events | The Chernobyl Gallery." The Chernobyl Gallery. February 15, 2013. http://chernobylgallery.com/chernobyl-disaster/timeline/.

31. "Chernobyl Disaster." Wikipedia. https://en.wikipedia.org/wiki/Chernobyl_disaster#Human_impact

32. Korody, Nicholas. "Between Sampling and Dowsing: Field Notes from GRNASFCK." Archinect. April 30, 2015. http://archinect.com/features/article/125765734/between-sampling-and-dowsing-field-notes-from-grnasfck.

FIGURE 48
"Timeline of Events | The Chernobyl Gallery." The Chernobyl Gallery. February 15, 2013. http://chernobylgallery.com/chernobyl-disaster/timeline/.

FIGURE 49
"Radiation-woman Finds Highly Gamma Radioactive Firemen's Clothes." LiveLeak.com. http://www.liveleak.com/view?i=976_1381332388&comments=1.

FIGURE 50
"Timeline of Events | The Chernobyl Gallery." The Chernobyl Gallery. February 15, 2013. http://chernobylgallery.com/chernobyl-disaster/timeline/.

FIGURE 51
"Timeline of Events | The Chernobyl Gallery." The Chernobyl Gallery. February 15, 2013. http://chernobylgallery.com/chernobyl-disaster/timeline/.

FIGURE 52
"Poliske: The Forgotten City of Chernobyl." Guillaume Herbaut Photography. http://www.guillaume-herbaut.com/en/.

FIGURE 53
"Pripyat Marshes." Nova Online. http://novaonline.nvcc.edu/eli/evans/his241/notes/geography/pripyat.html.

AGENT ORANGE, VIETNAM 1961-1971

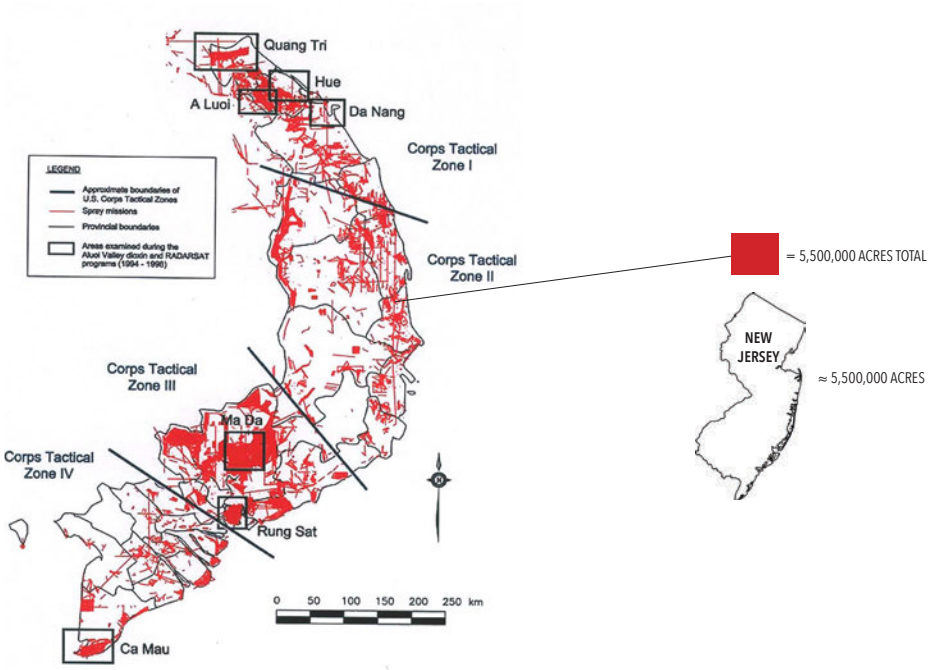
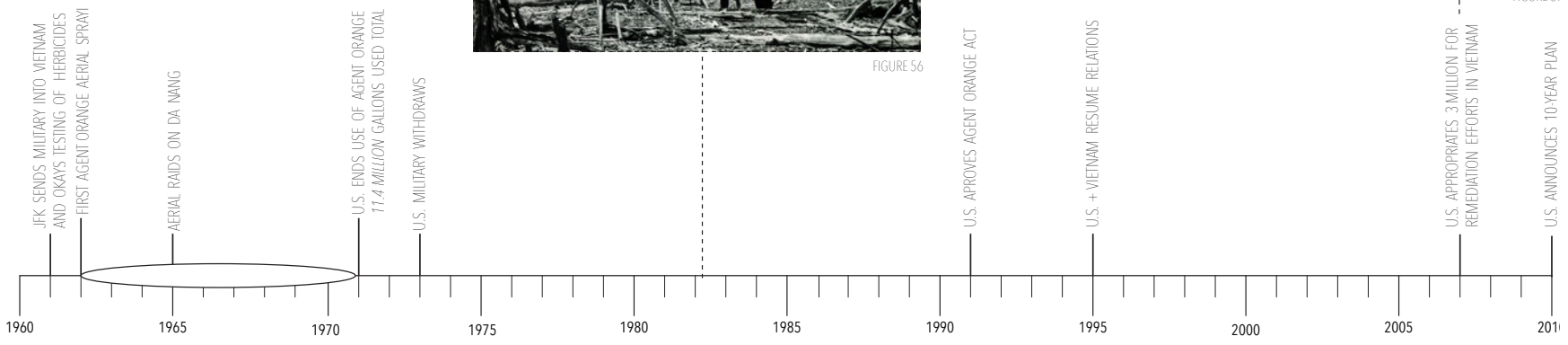


FIGURE 54

FIGURE 55

FIGURE 56

FIGURE 57



Pollution Type: Agent Orange was an herbicide developed by the U.S. government and used against the Vietnamese during the Vietnam War between 1961 and 1971. The herbicide contained the dioxin TCDD, a carcinogenic compound linked to death, illness, and mutations in humans. U.S. troops sprayed the chemical over 5, 500,000 acres of forest and farmland in Vietnam.[33]

Short Term Effects: The herbicide was meant to defoliate the forests along the Ho Chi Minh trail where VC troops easily ambushed American soldiers, but it also acted as a defoliant on cropland - causing food shortages and putting pressure on the VC troops. It is also highly toxin, and was linked to at least 400,000 deaths.[34]

Economic and Political Impact: The American government saw fit to utilized an herbicide as a war tactic, not understanding the long-term implications or the full range of affects that it would have on the humans exposed to it. There have been a high volume of lawsuits by American Vietnamese war veterans, and the American government has pledged to assist with the decontamination efforts.

Remediation Technique: Dioxin is not water soluble, but it does break down in sunlight and is washed away by rain, so little of the chemical sprayed by air remains. The problems today are caused by "hotspots", where the chemical was stored, leaked, or spilled. [35] Clean up of these spots involved isolation, containment, and then a technical soil cleaning process.

Long Term Effects: Today, Agent Orange has been linked to half a million birth defeats in children born to those exposed to the chemical, as well as upwards of 2 million cases of cancer in the Vietnamese and American war veterans.[36] The chemical TCDD is also still present in the food chain in Vietnam, as the chemical has remained in the soil, and is continuing to be exposed to new people that way.

Take Away: The effect of the herbicide on Vietnam is still largely being felt because of the way the contaminate is able to be genetically, and because of way that it contaminated the local's food source.

FIGURE 58

FIGURE 59


FIGURE 60

33. "Agent Orange." Wikipedia. https://en.wikipedia.org/wiki/Agent_Orange.

34. "Eating. Drinking. Touching. Breathing. Nursing. Conceiving." Agent Orange Record. 2010. http://www.agentorangerecord.com/impact_on_vietnam/health/.

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36. "Agent Orange." History.com. http://www.history.com/topics/vietnam-war/agent-orange.

FIGURE 54
"Agent Orange." Wikipedia. https://en.wikipedia.org/wiki/Agent_Orange.

FIGURE 55
Haberman, Clyde. "Agent Orange's Long Legacy, for Vietnam and Veterans." The New York Times. May 11, 2014. http://www.nytimes.com/2014/05/12/us/agent-oranges-long-legacy-for-vietnam-and-veterans.html.

FIGURE 56
"Vietnam War: Agent Orange." Tasia's Digital History Portfolio. https://sites.google.com/site/tasiasdigitalhistoryportfolio/vietnam-war-agent-orange.

FIGURE 57
"US Starts Agent Orange Cleanup." Stuff. http://www.stuff.co.nz/world/americas/7448018/US-starts-Agent-Orange-cleanup-in-Vietnam.

FIGURE 58
"The Vietnam War and Rural America." Farming in the 1950's and 60's. http://www.livinghistoryfarm.org/farminginthe50s/life_08.html.

FIGURE 59
"The Vietnam War and Rural America." Farming in the 1950's and 60's. http://www.livinghistoryfarm.org/farminginthe50s/life_08.html.

FIGURE 60
"Agent Orange in Vietnam." Nolan's Digital History Portfolio. 2015. https://sites.google.com/site/nolansdigitalhistoryportfolio/american-war-tactics-in-vietnam/agent-orange-in-vietnam.

[NEARER] FUTURE PROJECTIONS

THE PROJECT
JUDGEMENT DAY

Revkin, Andrew. "A fracking method with fewer water woes?". The New York Times, Opinion, DotEarth Blog. November 8, 2011. Accessed December 4, 2014. http://dotearth.blog.nytimes.com/2011/11/08/a-fracking-method-with-fewer-woes/.

"Energy needs and economic forces drive innovation, both in using energy more thriftily and finding new sources. Environmental issues arise. Pressure builds for change. Regulations and rules evolve. Industry resists. Lawsuits and environmental campaigns ensue. Innovations occur. And the human enterprise, often in a herky-jerky fashion, moves forward."

Peeples, Jennifer. "Toxic Sublime: Imaging Contaminated Landscapes." In Environmental Communication, 373-392. 4th ed. Vol. 5. 2011.

"Providing a visual representation of these sites of contamination is often necessary for eliciting social response and/or policy change."

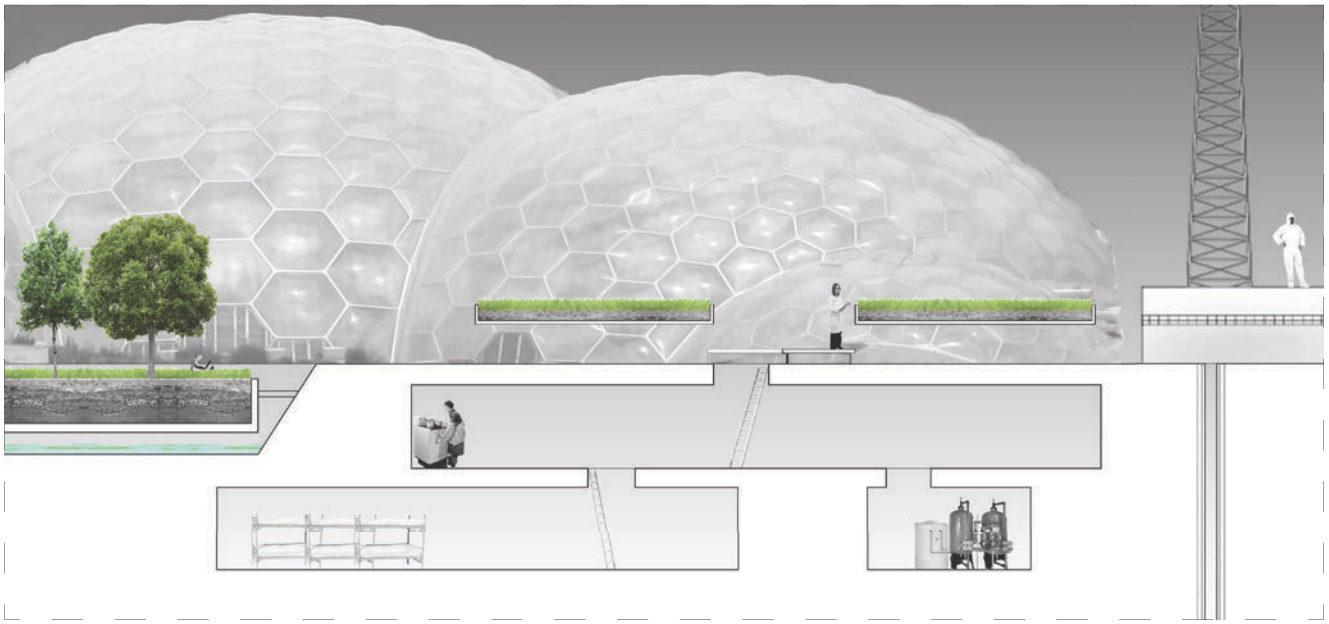
THE PROJECT

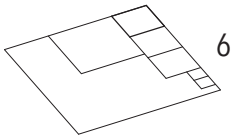
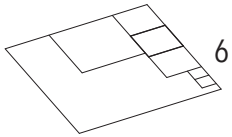
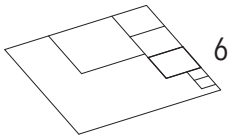
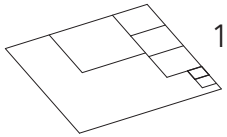
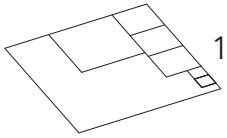
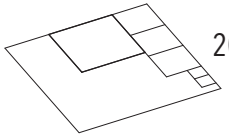
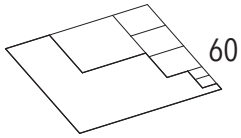
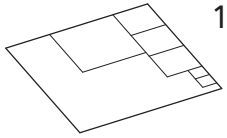
THE PROGRAM

The end product of "Collaborating with Catastrophe" will be a 100 acre farm, set in Washington County, PA, in the year 2030. Due to the fact that hydrofracking is still expected to be going on in the region, the project will be dealing with the overlap of the farming and fracking programs. Based on data offered by scientists from a variety of fields and institutions, this thesis also takes into consideration the effect of climate change and potential pollutants from fracking, and attempts to predict how architecture might need to respond - through new technologies, farming systems, or organizations.

Part of this involves designing around ancient methods of dry farming to deal with impending drought, and designing for hydroponics as a contingency in response to possible soil contamination from the on-site hydrofracking industry. The project will also include an imagined "algae intervention", in which all the typical farming and water treatment processes are altered to consider new technological insight into the applications of algae.

The typical farm is simple - in plan it is zoned for certain crops over certain areas, and in section it occupies a singular level. The farm of the future, in which a range of programs need to be integrated, cannot be beholden to those norms. It is the resultant of this hybridization that this thesis focuses on.



PROGRAM	AREA	PRIVATE/PUBLIC	INTERIOR/ EXTERIOR	FARMING/ FRACKING
WELL PADS (2) - DRILL RIGS - ON-SITE STORAGE - ON-SITE OFFICES	 6 ACRES	PRIVATE - RIG WORKERS	INTERIOR + EXTERIOR	FRACKING
INFRASTRUCTURE - ROADS	 6 ACRES	PRIVATE - RIG WORKERS + TRUCKS	EXTERIOR	FRACKING
WATER PITS + TREATMENT - ALGAE SYSTEM	 6 ACRES	PRIVATE - MIX RIG WORKERS + FARM HANDS	INTERIOR + EXTERIOR	FRACKING + FARMING
THE HOME - RESIDENCE (FAMILY STRUCTURE TBD)	 1 ACRE	PRIVATE - FARM OWNER + FAMILY	INTERIOR	FARMING
EQUIPMENT + CROPS STORAGE	 1 ACRE	PRIVATE - FARM HANDS	INTERIOR	FARMING
HYDROPONICS - GREENHOUSES - SUPPORT SYSTEMS	 20 ACRES	PRIVATE - FARM HANDS	INTERIOR	FARMING
DRY FARMING	 60 ACRES	PRIVATE - FARM HANDS	EXTERIOR	FARMING
TOTAL	 100 ACRES	PRIVATE		

JUDGEMENT DAY

The goal of this thesis is *not* to design the perfect farm of 2030.

The goal of this thesis is *not* to integrate hydrofracking and farming seamlessly.

The goal of this thesis is *not* to predict what climate change will bring or how it should be responded to.

These are merely the side effects of "Collaborating with Catastrophe". The endeavor, instead, is to use this thesis as a means of social critique. As, in the spirit of a jeremiad, the actual goal is to imagine a future post-apocalyptic world in order to highlight the absurdities of present day actions and their possible repercussions.

Architecture has the ability to imagine such a world and, through the tools of representation and narrative which all projects of the architect rely on, to become a means of communication. By working in this way, architects have the ability to take a place at the table in discussions which many would claim as being outside of the architect's realm. With the exception of the small percentage of designs that are ever realized in built form, when it is excepted that most architecture exists only as a fiction, the greatest asset of the architect is ideas, and adding those ideas to the world at large so that another voice might respond to them, and they might be built upon.

In the design of the Continuous Monument, by Superstudio, the goal was not to convince anyone that wrapping the world in a singular built form was a good idea, but rather to imagine what a unifying utopian act might look like (Figure 64). The goal of Edward Burtynsky's Ship Breaking photos was not to merely capture a sublime image, but to engender thought on what the implications of that toxic sublimity might be (Figure 62). The goal of this thesis is similar, in that it's success is based upon the conversations that it stimulates, existing merely as a means of propagating newer, better ideas as well as new understandings about present day society's failings.

In its final form, however, this thesis will also need to be a stand alone piece, complete in itself - similar to Burtynsky's photographs, each of which contain a subject and composition, while simultaneously being beautiful in their own right.

The final deliverables will be those typical of an architecture project - the plans, sections, axons, renderings, and diagrams which architects use as a means of communicating their fictions. It will also include a written piece, less typical of such projects, which will explore the day-to-day experience of the project.

FIGURE 61
The Road. Directed by John Hillcoat. Sony Pictures Home Entertainment, 2010. Film.

FIGURE 62
"Ship Breaking." EDWARD BURTYNSKY. 1996. http://www.edwardburtynsky.com/.

FIGURE 63
"Yakov Chernikhov." VisualizeUs. http://vi.sualize.us/yakov_chernikhov_constructivism_architectural_fantasy_picture_3X9g.html.

FIGURE 64
Glancey, Jonathan. "Anti-matter. Superstudio: Life Without Objects." The Guardian. March 31, 2003. http://www.theguardian.com/artanddesign/2003/mar/31/architecture.artsfeatures.

FIGURE 61


FIGURE 62


FIGURE 63


FIGURE 64

APPENDIX: A,B, C
GLOSSARY
BIBLIOGRAPHY

APPENDIX: A
COLLEEN TUITE INTERVIEW

11.28.15
BROOKLYN, NY

IMAGE 1 . GRNASFCK

Tuite graduated from RISD with an MLA in 2006. She is currently Co-director of the Brooklyn-based landscape architecture firm GRNASFCK with Ian Quate.

What was your undergrad in?

I went to art school in Chicago so, maybe as you can tell from GRNASFCK, Ian and I both have sort of an arts background, and so yea, it's definitely influenced what we do.

Yea, I can tell, your website is more installation based than "let's actually solve these things" which is kind of cool.

Yea, we're not engineers, so we're not going to solve them through engineering or technology, but I'm definitely very inspired by sci-fi and the thought of just putting ideas into the world. I had actually a profound experience at RISD – there was a professor of digital media who had spent a lot of time at MIT in the Media Lab, and she told this story about how all these guys who she worked with that are basically inventing all the stuff we use now or this myth of "oh sci-fi is so crazy, these guys were so mystical and thought up these ideas, but now they've come true. And she was like, no, it's just all these nerds who read it growing up and they were like "that's awesome" and then they make it, and that was a very "oh yea, putting ideas into culture and letting people sort through them" idea moment.

Yea, I totally agree, that's actually kind of how I'm spinning my thesis. It's going to be post-apocalypse based rather than solution. Cause hydrofracking, which is why I found you guys – because if you type "ecology" and "eschatology" and "hydrofracking" into Google enough times you guys pop up pretty quick – so I found your stuff and it totally sent my thesis in a different direction. Originally I thought hydrofracking is so interesting because it's a spatial problem and there's this programmatic overlap between the drilling and agrarian communities, and then there's the population influxes that happen around those areas, and then they leave, and then obviously there's pollution. So I was like, it's such an interesting issue that architects haven't touched, and I don't know why. So I started looking at it, and my thesis started going in the wrong direction, like "Oh, I'll solve hydrofracking" which is not the way to approach it at all. So instead I'm doing post-apocalypse, and hydrofracking is going to be in it, but its going to be an agrarian community of the future. But that's why I wanted to talk to you - because you guys went to North Dakota, and I'm sure you're still going to publish about it with Manifest, but they seem really behind.

Yea, Manifest and maybe a couple other places. We love them and they've been so good to us, but yea, they're just slow. We'll do something for them, and we just got asked by Berkley's landscape architecture journal to do something, and I think we might self-publish something. I don't know, a booklet or something. I mean, we were interested in it for the same reasons that you said – it's this huge thing nobody's touched, and its got all this morality wrapped up with it, and in terms of landscape architecture in the world it's huge.

I'm just so curious, Sunshine Eschatology, your Everglades project, was supposed to be published?

Yea, it's coming out now. It's been frustrating, but it should be coming out soon, and they've promised that they're going to pick up the pace. They're just guys too, and they're all finishing up their PhD's and stuff, so it's a little like well, "Ok, now we're doing this other thing". But yea, developing that format of travelogue style has been very cool for us.

Is that the major thing that you produce?

So far. I think next year we have something, I don't want to get into it too much cause nothing is real yet, but it looks like we'll be doing at least one commission, it's sort of an arts space. So yea, we're going to start building, which will be cool. But so far it's been mostly research based. Ian and I both sort of have our own take on things, and he's certainly much more active in the science side, but yea that's how we started collaborating and gone from there.

What did you do when you went to the Bakken? I read the Dowsing article, and you mentioned you were going to try to swab some drill pads. Did that work out?

Yea, a little bit. Actually I need to talk to Ian about what happened with that, but yea, Ian has been working on the Gowanus Canal project here, so he has all these contacts. Part of that project was to sample the soil sediment looking for basically new forms of life in the bacteria that's there, so he's been working with some folks at Cornell and also Genspace in the city, which is sort of a community genetics lab. So yea, he did take some samples, and I should ask him what happened with that. Mostly, like all the trips, we pick a place, we learn about it enough and then we go and bring our own agendas to it. But it was very cool to see.

What did you guys do?

Drove around a lot. We camp and - I can show you photos. So I'm sure you've looked at tons of stuff already, but the landscape looks like this (Image 1), and as you were saying it's super agrarian. That's Ian, that's my friend Katie who came with us who's also a landscape architect. It's interesting though, cause you get there and you're thinking it's this pastoral landscape that's being infiltrated by all these huge structures, but the landscape is already filled with machines. Big crop stuff, and lots of tractors, and irrigation systems. That was

kind of striking in terms of like "Oh, people have already altered the land". It's very mechanized already, even though it's pastoral. So it's kind of when you go places and you see things like that where you go "Oh, interesting." Then once we saw the drilling infrastructure, it kind of just seemed normal. Like, it wasn't as bad. At night, it's really crazy (Image 2). So this was in Williston, the whole landscape is just lit up with the fires from the off gassing. So they burn a lot. For a while they were burning almost a quarter of everything they were bringing up because there wasn't the structure to capture it. But there are different types, and for the ones where they're bringing up oil, they're also bringing up natural gas, and they flare that off, they don't capture it. So the whole landscape at night is lit up with the fires, it's really beautiful. It's one of those things where it's like, yea, I know this is a little F-ed, but it was really beautiful.

So this is them installing a fracking pad (Image 3). So obviously the structures around these are huge. It's funny though, cause we did some field reporting at night, and you can just walk right up to stuff, no one cares. There's no security, no anything.

Really? I might have to stop in Pennsylvania then on my way back to Syracuse.

That would be interesting just to see if there's any difference in terms of how things are maintained, but certainly out in North Dakota nobody cares.

So we flew into Minot and then drove a little bit north and through Saskatchewan for a little bit, and you can see it when you drive into the Bakken, it happens really fast. At first we were like "Oh, an oil well!" like, really excited, and then all of a sudden there are tons of them. And in Saskatchewan it was actually a little bit nastier than down in North Dakota. It looked worse; I don't know how to describe it. And also, in North Dakota there's tons of pre-fab housing (Image 4), but in Saskatchewan there were crazy mansions going up in the middle of nowhere. Obviously people had sold their land and had a ton of money now, but just the building thing is huge. So then we dropped down into Williston and had dinner with these family friends of someone through Ian. So Ian works for a landscape architect here, and one of his clients who he's been doing a project for is from Williston. It was a very funny interaction to figure that out I guess. So she set us up with this family friend who was this really sweet seventy-year-old woman, and she had a dinner party for us. It was actually really interesting. I was definitely anticipating these old, white, Christian people to be really against all these new people coming in and how their town is changing – you know they've all lived in Williston for decades, and the city has really changed in the past ten years – but they were all really into it. They were like "This is how we live out here. Our economy needs this, and it's really amazing that people are coming here and wanting to settle eventually, and maybe bring their families". There was a frontier open-mindedness that I had not expected I guess.

That is interesting. You've seen *Gaslands*, which is a lot of propaganda, but it just comes across as everyone in these places is so against it.

Yea, it's not like that. Actually everyone we encountered in North Dakota was definitely on board. We had a phone conversation with one… When I was in college I was really involved in activism, and I have this old friend from that time who lives in Colorado now and is very involved in anti-fracking stuff. So I reached out to him, and he set us up with this guy that is doing environmental work in North Dakota. We had a phone call with him and, you know, he's an environmentalist and into social justice, and I think at the end of the day he's against it, but he was like, that's not even a part of the conversation in the Dakotas. We're just trying to regulate. There's this idea in New York of having a moratorium, but that's not even the conversation, even from the lefty environmental groups. Just because there's no other economy. We're sort of privileged in New York that we can assert our values into it. Everyone we encountered was more or less like "Yea, it needs to be regulated" but in general people are very open, and in terms of the population they're like "Yea the city's changed, and now we lock our doors". But they just saw it as part of life.

That makes sense, cause it's like the Upstate Secessionist movement where upstate want to join Pennsylvania cause then they can frack without the ban and whatever. It's kind of a joke, but at the same time its not. Like, they've really thought about it and occasionally there's litigation, but it's because upstate is so different from downstate, and downstate runs the politics of the entire state. So it's like, you're not fracking here, and downstate is so liberal and left wing that the right-wing upstate that would be benefitting from it is like, how did you do this? So other than the academia in upstate, like Syracuse and Binghamton, like universities, everyone else is very pro-fracking. So I could see why Williston would've been that way as well.

Yea, certainly. I mean the open question as to what it's actually doing to the environment is so huge, but it's invisible – it's all underground. It's not like deforestation or these things that we can visually register in the landscape. It's all hidden. And even the whole waste water thing where they're reinjecting all the waste water, which is probably the biggest issue actually. But again, it's all this waste that's produced is hidden. So yea, I think it's very hard for people, especially if all of a sudden your land, which was worth "x" before is worth "x" times 100 now, you know? So at the end of the day I'm against it. It's so lame in a way, in terms of investing infrastructure into that versus other things. It's very clear out there, the oil companies know eventually it will be either gone or regulated where its far less profitable, so they're pouring everything into it now. If all that infrastructure was invested into renewables… But it's just making a buck.

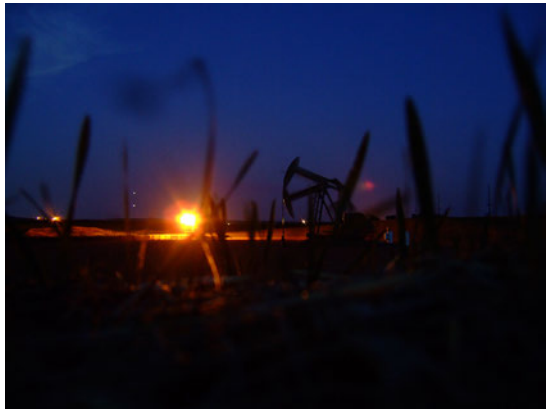


IMAGE 2 . GRNASFCK

IMAGE 3 . GRNASFCK

IMAGE 4 . GRNASFCK

IMAGE 5 . GRNASFCK

IMAGE 6 . http://fortune.com/north-dakota-fracking/

Are you guys planning on doing anything, putting anything out into the world? Are you proposing any ideas? Design or relationships?

Yea, I think we'll build a narrative around it. I'm not sure yet. I think eventually we were talking about like, it's the perfect studio in many ways. It's kind of ripe for that kind of… and there are so many constraints. Everything comes in on a truck. All the width of the housing and stuff is all the width of a semi truck – all the building materials, everything. So there are all these constraints, there's "x" amount of people, and in terms of leaving stuff behind, no one lives out there, really. Certainly, yes, people do, but it's a very uninhabited landscape.

And everything that they bring in they kind of take out with them too so they can use it on other sites.

Yea, you know, I bet it will be too expensive though. I bet a lot of the stuff will just get left. I mean, certainly some expensive equipment they'll take out, but I bet a lot of it is just cheaper for them to dump it. Everything is so financially driven, it's so clear. The women in Williston set us up to tour one of the man camps – so it's run by Halliburton, and it just felt like we were in Iraq or something. But this, exactly whatever this unit was, there was this whole infrastructure. It's built in I think 50 days or something in Texas, and then brought in on a truck, and it houses 500 people. They're all units, it's all modular. It's kind of weirdly nice. For a while, people were basically homeless out there. So it's just set up for work, there's places where they can put their stuff (Image 5). It's run by the holding company – it's run by Halliburton – its like a military contract – everyone just has weird different names, but all the guys that are there are Halliburton, but this place is run by "Target Logistics", and there's places where you can use the computer, game rooms, cafeteria. There's unlimited food in the cafeteria, just to keep people happy.

Makes sense with that many guys around. Don't they make awesome money too, the roughnecks?

Yes, that's another thing of it. Most of those guys that are out there are making money and sending it home to their families. Historically, the kind of relationship that's played out is migrant workers or immigrant workers, and it's totally the same thing here except it's domestic, where people come, and they don't live here. They'll have five weeks on, two weeks off to go home. The parking lot is license plates from all over the country. You make a lot of money; it's also really dangerous.

And they made it very clear here, there's no drinking, no drugs here. If you come back and you're fucked up, you're done, you're tossed. You can't live here. So there's this kind of weird rules, control thing. But at the same time we heard from multiple different people that there's so many drugs in Williston now, and women will come up from Vegas because they can make more in a weekend in Williston. We actually didn't really see that, but that is present. Like, working an extremely dangerous and taxing job, plus lots of money, plus lots of men. I went to buy beer, and it was just me cause Katie and Ian were doing something else, and I was waiting in line at the liquor store, and I was like "I'm the only woman in here", and it was definitely present. That was in not Williston, there was another town, almost more frontier. It was clear there was nothing there before, and now it had been built.

What were the demographics like, other than the male to female ratio? I don't know why, but I always get the impression that drill rig workers are white. Is that the case?

Yea, definitely most people out there are white. Almost everyone we saw was white. However, when we had dinner in Williston – so they were all really into God, and church and stuff, so they were all really excited that more people were joining the church, including a number of guys from Africa who are now coming. So it's kind of moved beyond domestic labor, so their families are still in Kenya or whatever. So now it's becoming more international. And they were really excited because those guys are also really Christian. But certainly, it's very homogenous.

What's the age range?

Just like young guys. 20 -35, maybe a little older. You need to be able bodied, and maybe you have a family, maybe you don't.

Yea, I have a friend, she went to Syracuse, and we have a really good broadcast journalism program, and she got a job as a newscaster in North Dakota. Right out of school, you know, take whatever you can get as long as there's airtime. So she moved to North Dakota, and since then she's dated maybe four different oilrig workers. She'll always call and be like "Oh I'm dating someone new" and it's like "What does he do?" and she's like "Oh, yea, he works on a rig".

Yea, I'll show you this photo (Image 6). This was this coffee place in Williston that's like definitely going with it. Just like, cute girls inside. There's definitely like a very strong… I mean it's a frontier situation, so that kind of always a machismo attached to it. But lots of really nice cars – obviously tons of trucks – but also people have money, just stuff men like I guess. That was definitely very clear in Williston in particular.

Do they have any pollution problems that you saw? Or did any of the residents talk about having problems?

Not really. I mean we saw the sites where they had the water dumping stuff. I should send you the interview we did with the environmentalist. I mean,

they've identified a number of problems, especially with the reinjection wells, where that has caused flooding in other places and contaminated peoples' water sources and stuff. But again it's this weird invisible thing. You don't see it. I guess the most visible thing is the road construction. Lots of the roads are just asphalt and now they're making it concrete because the trucks are so heavy they rip them up constantly. That's the interesting thing with the whole pipeline debate – I think Obama just killed keystone, but, that kind of thing in the past would've been like "Oh, good", but out there it actually would have way less impact to have a pipeline because the trucking thing is crazy. That's one thing that everyone complained about. It's really scary to drive now because there are so many trucks on the road and its people that don't know the area. We were there in summer, put in winter it's pretty hazardous, and if you're just some guy that showed up from wherever and you don't know how to drive… Maybe you know how to drive a big truck in North Carolina, but you don't know how to drive a big truck here. And the roads are all two-lane highways because five years ago there was like nobody out there, and now there's traffic.

It's too bad that we didn't need roads in the area that hydrofracking is happening, because then they could build the infrastructure that was needed, if we were actually westernizing.

Yea, but that's a big part of it. One of the guys we had dinner with is in the state legislature, and he was talking about how building the roads is actually the biggest issue, and the state is putting all this money into it because they want business, they are stoked. And that's the other thing, it's a conservative state anyway. They're making a ton off of taxes, but they could be making so much more. It's a big deal to improve the infrastructure to allow quicker extraction – then they make more money in the long run. The infrastructure thing is huge, and before it was just set up for farmers getting to the grain silos, and that was very present.

After visiting, are you pro the pipeline?

I mean, like I said, in terms of not thinking ahead of time, in the moment it actually makes a lot of sense because it'd be way less invasive in terms of trucking and so much stuff. However, like I said before, in terms of the infrastructure to build something like that, it's like ok, again, if that sort of energy and time and resources was put into renewables… but there's still so much money to be made.

I'm curious to hear, it sounds like you had had some issues at Syracuse with some people not being into the hydrofracking debate? I don't know, I feel like it's so important cause even as a designer, it's very rare that I go somewhere and think "This place needs design". Usually I like places and things that are undersigned, but North Dakota is one of the few places I've been that like "Wow, this place needs design".

It's very clear being out there, and just in general, this is happening, do you either want to be at the table or not? Do you want to just pretend that it's not happening?

Yea, it's like they're saying "We're fucked, so leave this issue alone and design another 21st century library of digital media", which drives me insane. Or do something about it. So I ended up going into eschatology and all that. But I was shocked by the lack of response that I got from academia.

Yea, it's funny, I'm not. It's tough, I like school a lot, so teaching is something I know I want to do at some point, but at the same time people like to see what they know, and it's scary to people to not know, and especially from liberal urban culture, to jump to a lot of conclusions about what stuff means. Certainly in terms of architecture and landscape architecture, we can talk about big urban infrastructure projects or whatever, but this is huge. The scale of this type of building, or drilling miles underground, it's so out of control that, I don't know, I just feel like knowing what's going on and wanting to respond to that, and honestly, I have mixed feelings about it. I know I mentioned I have a big activist past, however, these same companies, as soon as renewables become profitable, it'll be the same people involved. And they already know – I'm sure they're already working on stuff. Halliburton doesn't need to be educated on what they're doing – they don't care. But once renewables become profitable they'll just do that. They don't care whether its oil or wind or whatever, it's all the same to them. But in terms of just trying to be at the table or putting these ideas into architectural thought of how to design for infrastructure and for the future.

Yeam and I was going at this from a philosophical perspective. Toxic sublimity as the stage after technological sublimity, which is the stage after natural sublimity.

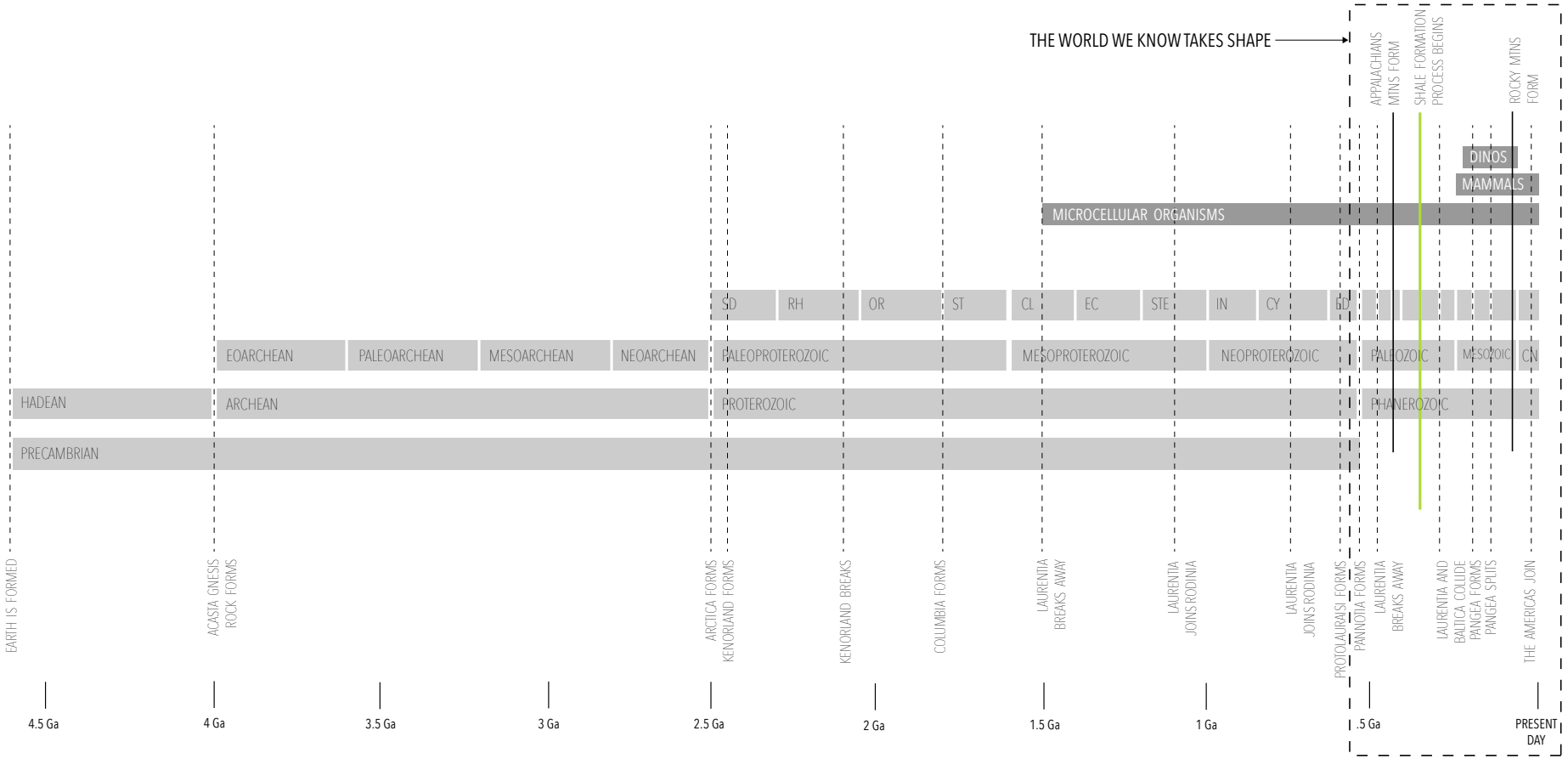
Yea, one of the last nights we camped in Roosevelt National Park, so that's a national park, but sort of enveloped in the state forests, and in the national forests you can frack. National forests are open to land use, so you can log… there's a lot of rules around it, but you can graze your cattle there, they're working landscapes even though they're preserved in certain ways. But yea, we were hiking through, and in the park that's ringed by the forest, and you can see there's tons of buffalo, and it's really beautiful, and you're in this kind of ancient feeling place (Image 7). No other people. And then ringed around you, you can see in the hills the flares. That kind of sublime… such a big take away for me is how beautiful that kind of thing is. People like machines. I don't want to romanticize in some ways what that is, but there's a certain power… So looking at them aesthetically is interesting.

-Conversation between Tuite and Cafferky

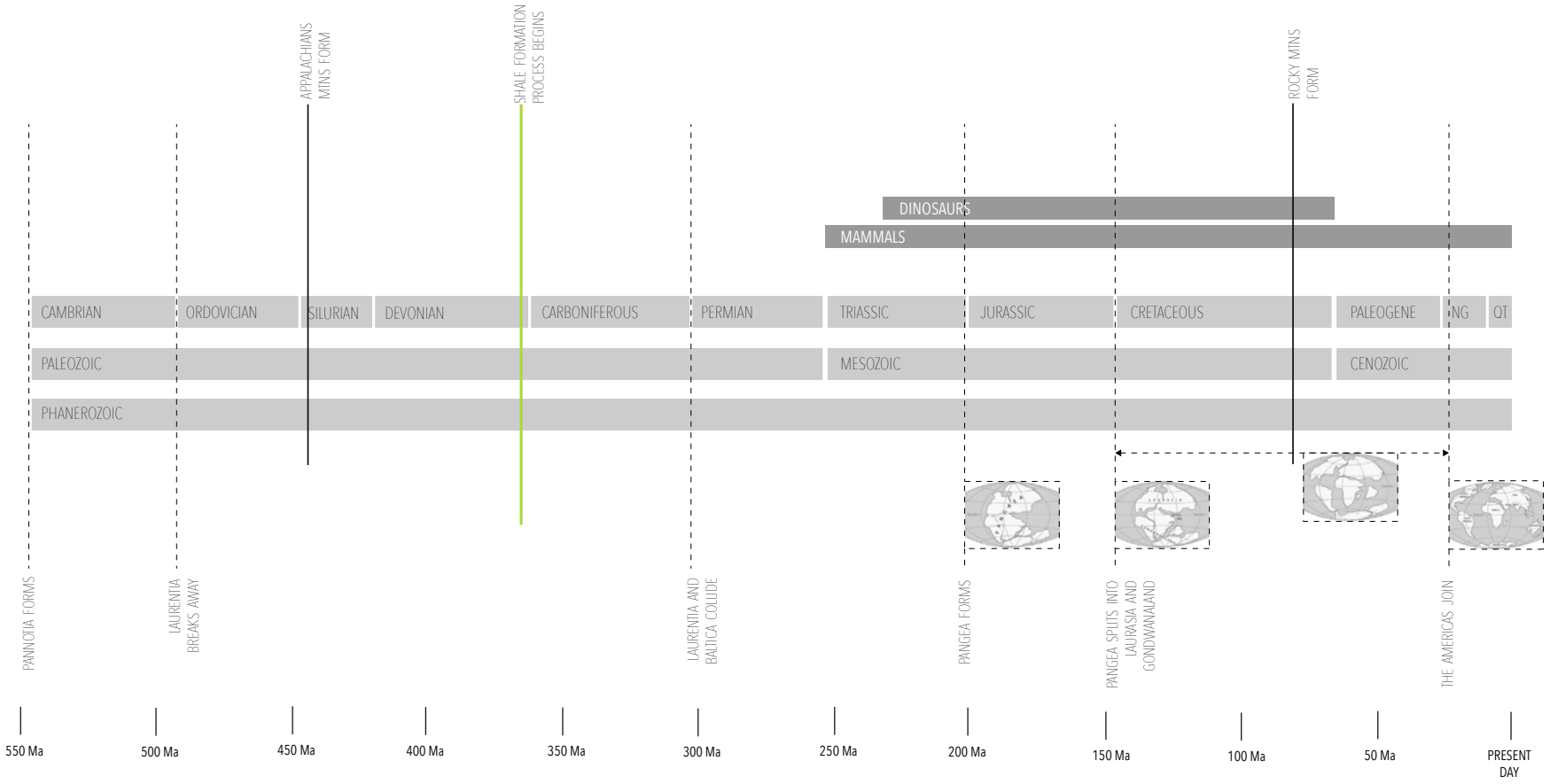
IMAGE 7 . GRNASFCK

APPENDIX: B

GEOLOGICAL TIMELINES



SD = SIDERIAN
RH = RHYACIAN
OR = OROSIRIAN
ST = STATHERIAN
CL = CALYMMIAN
EC = ECTASIAN
STE = STENIAN
IN = IONIAN
CY = CRYOGENIAN
ED = EDIACARAN
CN = CENOZOIC



NG = NEOGENE
QT = QUATERMARY

APPENDIX: C
THESIS PUBLICATION SPREAD

COLLABORATING WITH CATASTROPHE: THE USER'S GUIDE TO POST-APOCALYPTIC FARMING

The year is 2030 AD. Sea levels have risen, the ozone is breaking down, fresh water is increasingly scarce, and the ground beneath our feet in poinsoned. We've had to rapidly adapt our methods of food production, transit, and building shelter, to the harsh new conditions brought on by climate change and industrial pollution. Humanity is enduring, but only in the margins of what it once was. In the fight against global warming, architects believed their part to be in sustainable design, leading by example and attempting to slow the earth's rate of human induced decomposition. Society did not change radically enough, and the world suffered as a result.

This thesis contends that the narrative nature of architecture give it the potential to act as a jeremiad, taking the present day failings of society in the face of climate change and extrapolating out a potential future dystopia to instigate a critical dialogue and challenge the status quo. Here, architecture will act as a medium, as opposed to more typical literary works or photojournalism techniques which are usually associated with communicating social critique.

The project "Walking City" by Ron Herron of Archigram uses this technique of designing for a future post-apocalyptic world as a method of cultural commentary - proposing absurd, artificially intelligent robot cities that would roam the world in search of resources. Although this is an impossible, unbuilt project set in an unknown future, it manages to be significant and awe-inspiring for exactly those reasons. "Collaborating with Catastrophe" is similarly set in a post-apocalyptic future, but provides a clear cause for the impending disaster and a clear program on which to focus the after-effects of such changes.

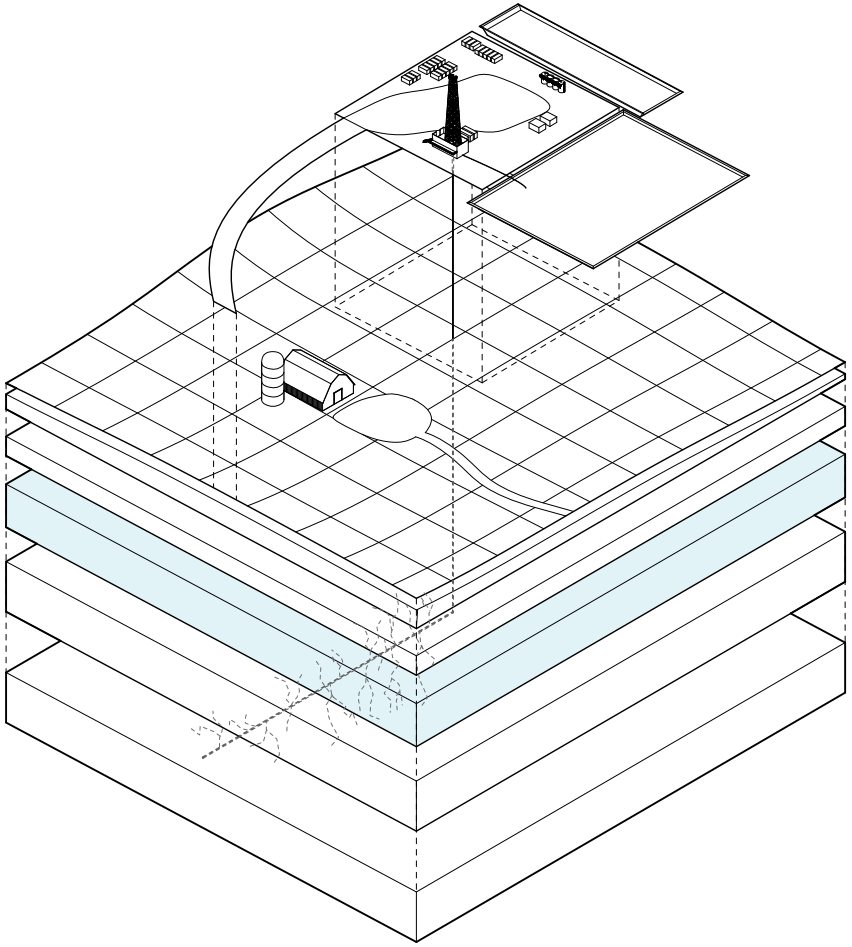
Jeremiads require a specific moral failing on which to focus. This thesis focuses on capitalism and it's inherent externalizing of costs on the environment, including water and ecological systems, soil fertility, and the climate.[1] This remains too broad, however, and so "Collaborating with Catastrophe focuses in on one of the most recently developed instances of capitalist externalization of cost in America - the process of Hydraulic Fracturing, or "Fracking". A harsh drilling process used to release natural gas from geological shale formations miles beneath the Earth's crust., the process is highly controversial, with numerous harmful side effects on the environment including, but not limited to, pollution of water sources, fugitive emissions, and destruction of the countryside – both spatially and socially.[2] Most concerning, however, is the programmatic overlap of fracking with agrarian America, where clean water and soil are relied upon to produce food for the country.

The second requirement of a jeremiad is the post-apocalyptic prediction, and so "Collaborating with Catastrophe" asks what would farming look like in not-so-distant year of 2030, if fracking pollution was worst case scenario and the rest of the environment had degraded as scientists predict it will. How ridiculous must the farming systems and technologies become in order to counteract the damage done to the countryside, and what does that world look like? The goal is to evoke commentary and deliberation about state of present and future society, much like Archigram's Walking City – capturing the sublimity and absurdity of unchecked human-caused destruction as a means of instigating change.

1. Huber, Matthew. *Lifeblood: Oil, Freedom, and the Forces of Capital*. U of Minnesota, 2013. Print.

2. Prud'homme, A. (2014). *Hydrofracking: What Everyone Needs to Know*. New York, NY: Oxford University Press.

OPTION 1



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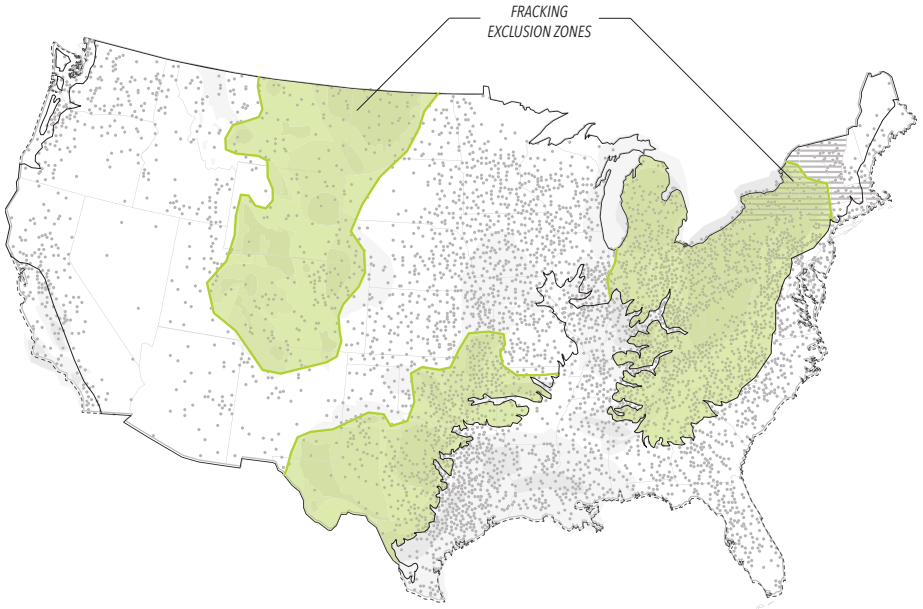

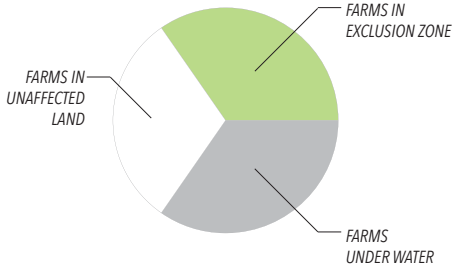

GLOSSARY
TECHNOLOGY + GEOLOGY

CO^2 EMISSIONS
ALSO CALLED A GREEN HOUSE GAS, CARBON DIOXIDE EMISSIONS ARE A CONTRIBUTOR OF GLOBAL WARMING. TOGETHER WITH METHANE EMISSIONS AND OZONE EMISSIONS MAKE UP THE CARBON FOOTPRINT.

FLOWBACK WATER
THE FLUID THAT FLOWS TO THE SURFACE DURING AND AFTER THE HYDRAULIC FRACTURING PROCESS. IT INCLUDES CHEMICALS, PROPPANTS, AND CLAYS AND MINERALS LOOSENED UNDERGROUND DURING THE FRACKING PROCESS. THIS IS "WASTE WATER" WHICH MUST THEN BE TREATED. OFTEN THIS INVOLVES INJECTING THE WATER BACK UNDERGROUND INTO STORAGE WELLS, OR SHIPPING IT TO TREATMENT CENTERS VIA TRUCK.

FUGITIVE EMISSIONS
METHANE GAS THAT RISES TO THE SURFACE AND IS NOT CAPTURED, AND RISES INTO THE ATMOSPHERE DURING THE FRACKING PROCESS.

HALLIBURTON LOOPHOLE
THE 2005 EXEMPTION UNDER WHICH COMPANIES ARE NOT REQUIRED TO DISCLOSE THE LIST OR AMOUNTS OF CHEMICALS THEY USE IN THE HYDROFRACKING PROCESS, CLAIMING SUCH INFORMATION IS A TRADE SECRET.

HALO EFFECT
WHEN A FAVORABLE EFFECT IS ABLE TO BE SHARED BY SIMILAR PRODUCTS DUE TO ASSOCIATION - EITHER BECAUSE OF PERCEPTION OR RELATED NEEDS.

HYDROFRACKING FLUID
USUALLY 99% WATER, AND 1% PROPANT GELS AND UP TO 600 DIFFERENT CHEMICALS (ALTHOUGH ONLY 3-12 KEY CHEMICALS), WHICH IS INJECTED INTO THE BOREHOLE AFTER DRILLING HASE ENDED. PROPANTS ARE SMALL PARTICULATES, TYPICALLY GRAINS OF SAND, THAT ARE USED TO KEEP THE FISSURES IN THE SHALE OPEN POST-CRACK.

METHANE MIGRATION
THE ABILITY OF METHANE GAS TO SEEP UNDERGROUND FOR UP TO SEVEN MILES, TRAVELING THROUGH NATURAL FAULTS AND FISSURES CREATED BY FRACKINGS.

MINERAL RIGHTS
THE RIGHT TO EXPLOIT AN AREA OF LAND FOR ITS MINERAL RESOURCES. THIS IS ABLE TO BE SEPERATED FROM PROPERTY OWNERSHIP IN THE SAME WAY THAT AIR RIGHTS ARE IN CITIES.

NATURAL GAS
A PURE FORM OF FOSSIL FUEL, WHICH IS COMPOSED OF METHANE. LIGHTER THAN AIR, AND WITH NO ODOR, IT IS USUALLY FOUND DEEP UNDERGROUND AND IS HIGHLY FLAMMABLE. NATURAL GAS IS A MUCH CLEANER ENERGY THAN COAL, AND SAFER THAN NUCLEAR. MEASURED IN MBTUs.

RENEWABLES
MADE UP OF THE FINELY GRAINED SHALE SEDIMENTARY ROCKS, SHALE FORMATIONS ARE LOCATED AN AVERAGE OF 10,000 FEET BELOW THE EARTH'S SURFACE.

RESHORING
THE PROCESS OF BRINGING BACK OUTSOURCED INDUSTRY TO ITS HOME COUNTRY AFTER BEING SENT OFF SHORE DUE TO CHEAPER OPERATING COSTS

ROUGHNECKS
AND OIL RIG WORKER. A POLITICALLY INCORRECT TERM REFERRING TO THE "UNCOUTH-NESS" OF THE USUALLY MALE WORKERS. NOTABLE FOR BEING VERY TEMPORARY HELP, MOVING AROUND OFTEN TO FOLLOW WORK.

SHALE FORMATIONS
MADE UP OF THE FINELY GRAINED SHALE SEDIMENTARY ROCKS, SHALE FORMATIONS ARE LOCATED AN AVERAGE OF 10,000 FEET BELOW THE EARTH'S SURFACE.

SHALE GAS
NATURAL GAS TRAPPED IN MINISCULE DEPOSITS EMBEDDED IN SHALE ROCK FORMATIONS. TODAY SHALE GAS PROVIDES OVER 20% OF US NATURAL GAS, AND BY 2035 IT IS ESTIMATED THAT IT WILL MAKE UP OVER 45%.

PROPANTS
USUALLY GRAINS OF SAND OR MINISCULE MAN-MADE CERAMIC BEADS ADDED TO FRACKING FLUID TO HOLD OPEN FISSURES MADE IN THE FRACKING PROCESS SO GAS CAN ESCAPE.

PHILOSOPHY

JEREMIAD
A LITERARY WORK OF PROSE WHICH BITTERLY LAMENTS THE MORAL FAILINGS OF A SOCIETY, AND EXTRAPOLATES THE EFFECTS OF THOSE FAILINGS INTO A PROPHECY OF CATASTROPHE. ORIGINATING WITH THE BOOK OF JEREMIAH IN THE OLD TESTAMENT, THE GOAL IS TO FORCE SOCIETY TO REEVALUATE ITS MORALITY AND CHANGE IN THE HOPES OF AVOIDING THAT DYSTOPIAN FUTURE.

SUBLIME
THAT WHICH IMPRESSES THE MIND WITH A SENSE OF GRANDEUR AND POWER, INSPIRING AWE, VENERATION, AND EVEN FEAR. USUALLY USED TO DECSCRIBE POWERFUL ACTS OF NATURE, THE TERM WAS COINED BY EDMUND BURKE IN 1757.

TECHNOLOGICAL SUBLIME
A TERM COINED BY DAVID NYE IN 1994 TO DESCRIBE THE FEELINGS EVOKED WHEN WITNESSING ACTS WHICH DEMONSTRATE HUMAN ACHIEVMENT AND THE CONQUERING OF NATURE'S LIMITATIONS. AWE AT WATCHING A SPACE CRAFT LAUNCH OR SEEING A SKYSCRAPER FOR THE FIRST TIME WOULD FALL INTO THIS CATEGORY.

TOXIC SUBLIME
THE TENSIONS THAT ARISE FROM RECOGNIZING THE TOXICITY OF A PLACE, OBJECT OR SITUATION, WHILE SIMULTANEOUSLY APPRECIATING ITS MYSTERY, MAGNIFICENCE, AND ABILITY TO NSPIRE AWE.

ECOLOGY + AGRICULTURE

ABIOTIC FACTORS
NONLIVING PHYSICAL AND CHEMICAL COMPOENTS OF AN ENVIRONMENT (I.E. MINERALS, LIGHT, MOISTURE, TEMPERATURE, ETC.)

AGROECOLOGY
THE SCIENCE OF APPLYING ECOLOGICAL CONCEPTS TO THE DESIGN AND MANAGEMENT OF THE SYSTEMS OF FOOD PRODUCTION (I.E. AGRICULTURE).

AQUAPONICS
A PROCESS BY WHICH THE WASTE PRODUCED FROM FARMED FISH OR OTHER AQUATIC ANIMALS SUPPLIES NUTRIENTS FOR HYDROPONICS AND SIMULTANEOUSLY PURIFIES THE WATER.

BIOTIC FACTORS
THE LIVING COMPONENTS OF AN ECOSYSTEM THAT INTERACT IN THE ENVIRONMENT (I.E. PLANTS, ANIMALS, FUNGI, BACTERIA, ETC.)

DRY FARMING
CROP PRODUCTION DURING THE DRY SEASON IN A REGION THAT RECIEVES 20" OR MORE RAIN A YEAR, OR FARMING IN AN ARID REGION.

ECOSYSTEM
A FUNCTIONAL RELATIONSHIP BETWEEN LIVING ORGANISMS AND THEIR ENVIRONMENT - OR THE COMBINING OF BIOTIC FACTORS AND ABIOTIC FACTORS.

EXTREMOPHILE
ORGANISMS THAT THRIVE IN EXTREME ENVIRONMENTS, INCLUDING HIGH TEMPERATURES AND PRESSURES, OR IN THE PRESENCE OF TOXICITY. USUALLY FORMS OF BACTERIA OR ALGAE.

HYDROPONICS
A PROCESS OF GROWING PLANTS IN SAND, GRAVEL, OR LIQUID, WITH ADDED NUTRIENTS, BUT WITHOUT THE PRESENCE OF SOIL.

FALLOW
LEAVING FARMLAND UNSOWN FOR A PERIOD OF TIME IN ORDER TO RESTORE SOIL FERTILITY. PART OF A REGULAR CYCLE OF CROP PRODUCTION.

REGOLITH
THE LAYER OF EARTH BETWEEN THE SOIL AND THE BEDROCK, MADE UP OF A HIGH PERCENTAGE OF MINERALS DERIVED FROM THE BREAKDOWN OF THE BEDROCK BELOW

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